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EXPERIMENTAL MUSICAL INSTRUMENTS

For the Design, Construction, and Enjoyment of Unusual Sound Sources

SIRENS AND SYMPATHETICS

Everyone knows what a siren sounds like, but not everyone knows how sirens work. Nor is it widely known that the sound-making principle of the siren has a colorful history in early acoustics research, and that in the hands of various experimenters sirens have taken many forms. Some of those forms have potential as playable musical instruments. In a two-part article appearing in this issue of *Experimental Musical Instruments* and the next, we will be learning all about sirens, their history, their acoustics and their construction.

Also in this issue we have reports on creative instrument making by two artists better known for their work in other areas: pop artist Robert Rauschenberg and composer Percy Grainger. You'll also find an article on the Cat's Cradle, the electronically-active sympathetic-strings instrument you can see in the picture at right. Beyond that, we have fanciful brass instrument forms from the Loop Group ensemble; an inexpensive electronic keyboard deliberately mis-wired by Reed Ghazala to reveal its hidden personality ... and, as always, much more.

So open now, and read.

Above: John Gzowski with the Cat's Cradle. See the article starting on page 19.

MR. BRUNELLE'S ARTICLE is fascinating ["The Art of Sound Effects," Parts 1 and 2, by Ray Brunelle in *EMI* Volume 12 # 1 and 2, Sept. and Dec. 1996]. He makes the trap set central. This was made possible by the invention of the bass drum pedal. This we owe to one Dee Dee Chandler who was the drummer in the orchestra of Jean Robicheaux in New Orleans at the turn of the century. Robicheaux's orchestra was a "society" orchestra, a black, note-reading, non-improvising group that commanded the highest fees and was very much in demand at classy events. Chandler's pedal was fastened on top of the bass drum and swung down to hit the head. The idea was an immediate hit with the pit drummers in the Vaudeville houses. I do not know who moved the pedal to the floor but it was there by the time jazz moved to Chicago. Baby Dodds was the most influential traps performer.

The influence of the drum set is wide-spread but seldom commented on. A number of ethnic musics that never used it have adopted it. This includes the blues bands, the polka bands, the Greek (so-called "buzuki") bands, the Irish "coelid" dance bands, the Brazilian zamba bands and various Caribbean types. Dee Dee has a lot to answer for.

Ray Wilding-White

I MUCH APPRECIATED Jason Gibb's "A Musical Instrument Workshop in Hanoi" [in *EMI* Vol. 12 # 1, Sept. 1996]. Ta Thâm's work is admirable. All I want now is a few more pages on the *Đàn bâu*!

When a young Vietnamese musician played his amplified *Đàn bâu* with an orchestra in Tokyo several years ago, I noted some of the orchestra members looked green with envy. The playing was *that* expressive. It may use "harmonics exclusively," but to my amateur ear, the instrument seemed to do *anything*.

Unfortunately, even an up-close view after the performance didn't reveal the way the piano wire was attached to the inside of the gourd or the way the pitch-bending lever itself was attached inside the instrument. Can anyone provide us with an *anatomy of the Đàn bâu*? If any instrument deserves such full treatment it is this one.

Also, I wonder if Mr. Gibbs can vouch for the hands. The musician I watched used his right hand to lever the pitch, and his left hand to stop the string and pick. Since it is possible to play a guitar fingering alone, this made sense to me. Mr. Gibbs has it the other way around. Are there perhaps two schools of *Đàn bâu*? Or, was one of our performers left handed?

Robin Gill

I HAVE BEEN SEARCHING for something. Perhaps you can give me some ideas as to where to search these things out.

I play woodwind instruments and have wanted for some time to create pieces which incorporate objects that sympathetically resonate in the performance space. I imagine these resonating instruments to be made of metal — perhaps disks of some sort.

These instruments would have interesting and unique resonating qualities — interesting and unique sound colors throughout their response range. Not gong or cymbal-like resonances. They would have to be very sensitive to incoming vibrations.

In performance, a saxophone pitch is sounded and the disks begin resonating, each with its own color. As the pitch of the saxophone changes the sound colors of the disks would shift and change.

Any information or help would be greatly appreciated.

Joseph Tornabene
le van Swindenstr. 521, 1093 LC Amsterdam, The Netherlands.

I AM A PERCUSSIONIST who would like to record waterphones and similar instruments that are played in a tub of water. I would like to buy a hydrophone (underwater microphone) to record the sound from above and in the water at the same time. I would appreciate any suggestions for a source of relatively low-tech (depth is not a problem!) hydrophone that can be plugged directly into a tape recorder or PA system (either high or low impedance). Thanks!

Joe Cochran
1605 Greenwyche Rd., Huntsville AL 35801;
phone (205) 534-8118; e-mail invenanet@worldnet.att.net.

Colin Hinz, who explores the quirkier side of mechanical sound instruments (see his article "Activities to Date at ASFi Music Works" in EMI Volume 10 #1, Sept. 1994), recently sent an update on some of his recent activities. Here are a couple of useful tidbits:

I'VE BEEN A SUBSCRIBER to the *Mechanical Music Digest* (rolls-request@foxtail.com) for about a year now, and it's brought me in contact with a lot of very interesting and helpful people. However, the *Digest* is not all seriousness, as witnessed by the recent discussions on how to make a roll-playing player bagpipes. The real trick is sounding the drones without having continuous slits in the roll, but there are tried and true methods for dealing with that ....

...I've done very little work with "experimental" instruments of late, aside from constructing a box which allows anywhere from 1 to 4 music boxes to play at the same time, from slow to absurdly fast speeds. (A quick experiment worth trying, if you ever find a musical box movement which doesn't have a clock-work motor: connect the cylinder drive shaft to a high speed motor, and let 'er rip at a few hundred RPM. The normally trite tunes these movements play get transformed into a continuous tinkling sound.)

Colin Hinz

NOTES FROM HERE AND THERE

A NEW HOME FOR A FINE OLD COLLECTION: One of the world's leading collections of historical and contemporary musical instruments has historically resided at the Paris Conservatoire, with roots extending as far back as the French Revolution. The collection has now moved to the *cité de la musique*, "a place of teaching and learning, musical practice and listening" created by the French government in the years since 1979. The new musical instruments museum within the *cité*, called the *musée de la musique*, opened in January of 1997. It includes a technical restoration laboratory, research and documentation center, and a cultural service (mediating between the collections and the public), in addition to housing the public exhibits and permanent collection. *Cité de la musique* is located at 221, avenue Jean-Jaurès, 75019 Paris, France. For information phone 01 44 84 44 84.

I AM LISTENING, "an exhibit of sculptural sound installations linking the visible with the audible," took place at the Glendon Gallery of York University in North York, Ontario in June of 1995. At *EMI* we just recently received a copy of the catalog for the exhibit — a catalog which takes the unusual form of a video cassette. The video is presented as a walk through the sights and sounds of the exhibit, augmented by interviews with the artists and some performance footage. Included among the artists: Charles de Mestral, Raymond Gervais, Nobuo Kubota, Reinhard Reitzenstein, Jocelyn Robert, David Rokeby, Gayle Young, Kathy Kennedy and Critical Band. The video is available from Glendon Gallery, York University, 2275 Bayview Ave., North York, Ontario, Canada M4N 3M6, phone (416) 487-6721.

ANTHONY BAINES, one of the leading organologists of recent times, has died. He was a founding member in 1946 of the Galpin Society (organization devoted to the study of musical instruments) and editor of its journal for over 20 years. He authored *The Oxford Companion to Musical Instruments* (1991), a major general reference works in the field, as well as countless other scholarly writings on musical instruments.

THE LAST CASTRATO? Frederick Crane, editor of the jaw harp journal *V.I.M.*, has noted in a letter to *EMI* that the description of one of the musical instruments in a recent recording review may have been inaccurate. The review was of the disk entitled *The Last Castrato: The Complete Vatican Recordings*, appearing in *EMI* Vol. 11 #2, December 1995. It features recordings made in 1902 of the male soprano Alessandro Moreschi. Fred Crane, in his letter, says that Moreschi was not, as the disk title indicates, a castrato. "He was examined by a doctor, who found that he had a rare condition in which he simply never went through sexual maturity. But there never was an operation. Yet the myth persists very strongly."

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EXPERIMENTAL MUSICAL INSTRUMENTS
For the Design, Construction and Enjoyment of Unusual Musical Sound Makers

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ADVERTISING POLICY: Experimental Musical Instruments will run ads which are potentially interesting or valuable to the readership. Please write for advertising rates. Subscribers can place "classified" ads of up to 40 words without charge.

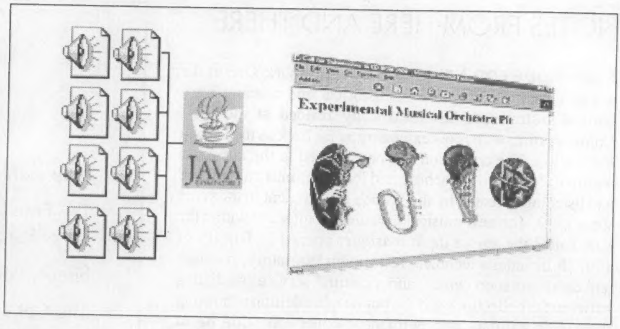
SUBMISSIONS: Experimental Musical Instruments welcomes submissions of articles relating to new or unusual musical instruments. A query letter or phone call is suggested before sending articles.

A CALL FOR SUBMISSIONS

Glenn Engstrand writes:

All experimental musical instrument inventors and players who subscribe to *EMI* are invited to participate in a Web-based, multi-media CD-ROM project. This CD-ROM serves as a "time capsule" that chronicles, from the hearts of artists, the human condition at the end of the millennium.

Part of this project will include a series of "orchestra pits" of experimental musical instrument players. Each pit will contain a different grouping of instruments based on some relevant abstraction or aesthetic. Each pit will be presented to the patron/user as a Java-driven web page filled with a table of icons, each icon representing a different musician/instrument.



When the user clicks on an icon, a small sound clip will play. Each time the user clicks on an icon, a different clip (chosen at random from the set of files associated with this instrument) will play. Each clip will contain a single musical lick. The user will be able to click on multiple icons in rapid succession thus causing samples to overlap. The only samples that will not be able to overlap will be those from the same icon.

The user participates in constructing a piece from this assortment of musical licks. Thus the user functions as the "conductor" of this Experimental Musical Orchestra.

How to Participate

Simply record and send to me a session of the instrument being played as a series of musical licks.

Naturally, the heart of an experimental musical instrument is that it is experimental. So, submitting a tape of everyday noise makers interestingly performed would be just as valid as submitting a tape of samples made from a single physical object.

A lick could be as simple as a single note or as complex as a two minute run of notes/effects/whatever. The word "note" here does not necessarily mean to be taken in any kind of formal western sense. On the other hand, I do not mean to discount western tonality.

You do not need to incorporate the licks into a real piece. In fact, it would be easier on me if there was some silence between each lick.

You also need to send me some graphic that is indicative of you and your music. Please use a graphic that still looks good after being reduced to a small image. As with any submission to CD2000, you need to include a small photo of yourself and a short description of you and your work. Those whose submissions get used will receive two copies of the mass-produced CD.

Send submissions to Glenn Engstrand, 3180 Maybelle Av, #7, Oakland, CA 94619

AND ANOTHER CALL FOR SUBMISSIONS

Luca Miti writes:

I am inviting you to participate in a collective project that is based on the creation of new musical Instruments, and on the composition of a work for them.

Send me one (or more, if you like) instruments *created by you* for this project. The instrument could be of any nature: acoustic, electronic, conceptual, etc.; note that "new" can be interpreted in various ways: a new instrument, of course, but also a new approach to it, or a new conceptual view of it, or something else to be created (by you!).

If you think it could be useful, you can send me, together with the instrument, an "instruction manual" for it (created by you, of course), a commentary, etc.

Send the finished instrument, not projects (if possible and if in line with your way to work for this project). Then I'll compose a work for all the received instruments. You can, if you want, contribute to this work by sending me any kind of suggestion about the playing of your instrument (this suggestion may vary between one word and a score to be inserted in the final work).

This will be performed and recorded. You'll be informed about any performance of it. The recording will be published on a CD (or a tape if on CD should be impossible) that I'll send you.

The period in which I want to receive the instrument depends on you. I mean that I don't like deadlines, also because they're often moved. So work quietly and send me the instrument *as soon as you've finished it*. Send it to:

Luca Miti, Via Tripoli, 110, 00199 Roma, Italy.

I'd add something else about the several extra-musical aspects of this project (social, political, ethical), but this could be a work to make together, too. So: that's all.

Computer graphics on this page created by Glenn Engstrand in connection with the CD-ROM "Orchestra Pit" project.

Ángel Sampedro del Río, who authored the article "The Development of Bamboo Saxes from Argentina" [EMI Vol 12 #2, December 1996], recently sent along some comments concerning the "Ramblings" column appearing in our June 1996 issue. In that column, Bart Hopkin discussed "movable toneholes" — that is, techniques for giving wind instruments flexible pitch. In his note Ángel suggests several simple and promising ideas, related to those discussed in the "Ramblings" column. Here are his comments and drawings.

MORE ABOUT MOVABLE TONEHOLES

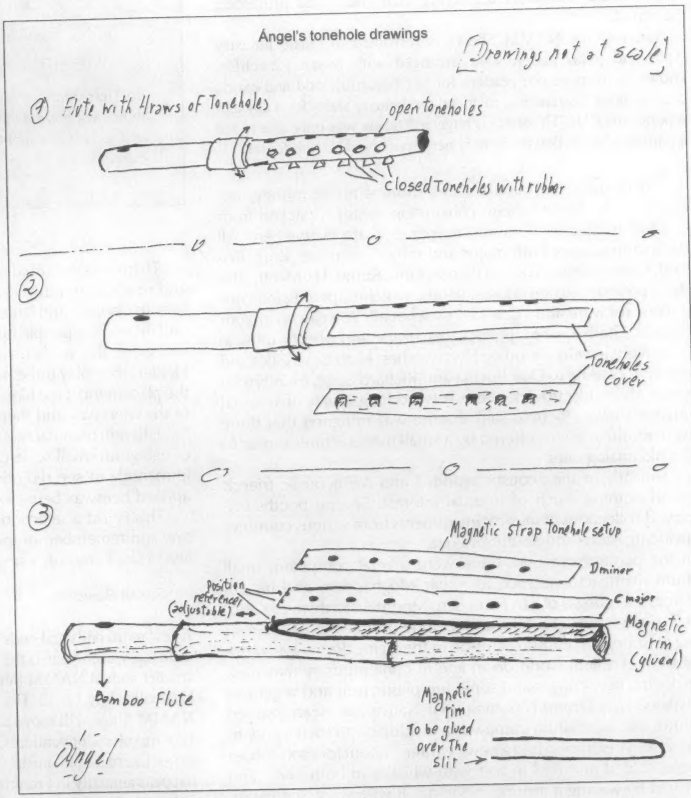
After reading the "Ramblings" column in *EMI*'s June 1996 issue, I have some thoughts. For example, the other day I was recording some music for a friend who showed me a kalimba, some percussion and a didjeridu. I had in hand a quena and a moxeño [large bamboo flute], but when I heard the music I said to myself "I need another scale." Yes, I could have used half- or quarter-holing, cross-fingerings, etc. But the moment required another more "fluent" approach. Recalling the article, I thought about a flute with more than one row of toneholes, which the musician could choose between following his or her spontaneous feeling.

I'm not a musician, but a flute maker. Therefore my mind ran to the design of this flute. I know that what I wanted was not a slide-whistle — I wanted precise pitches, without need for adjustment by ear.

The first question was: Why not two or three different flutes? I guessed that a one-mouthpieced multiflute would be better, to avoid embouchure and timbre changes. Thus, we could have four or five flute bodies made for a single mouthpiece, and shift them as needed.

Or a flute with removable mouthpiece, with four rows of six holes of different sizes and/or distances, where three of the rows are covered by rubber tape (Drawing #1). Following this design, I conceived a fast changing system by mounting these rubber tapes on wood, or better on cloth, making a tonehole cover system (Drawing #2). But with this design the flute retains the same pitch for the lower tone; you can only modify the scale.

As a hybrid design with the slide clarinet discussed in the "Ramblings" column, I can imagine either a steel or a bamboo flute with an open slit having an iron rim, and several different hole rows drilled in separate



magnetic strips (Drawing #3). [The "Ramblings" designs involved a magnetic strip designed to stick in place and seal air-tight over an open slit in a steel flute body.] The strips would hold magnetically onto a belt-sanded surface of the flute. (Obviously, the flute might be a side blown, a notched end, or also a clarinet!). The bamboo version demands more precision in order to make and glue another magnetic rim along the slit. A few reference points would be needed to attach the strip in the correct position.

These strips might be of diverse lengths, leaving in some cases an open slit portion at the far end of the flute.

The legion of strips could be infinite … made to produce major scales, minors, Lydian, Mixolydian, Dorian … in C, Db, D … all with a single mouthpiece and body. With a careful assessment of the effects of different mouthpieces on the pitch, we could use the same set of strips for a flute, or for a quena, a shakuhachi, a clarinet …

THE 1997 NAMM SHOW

Once a year the International Music Products Association sponsors the Winter NAMM Show. The show, which traditionally takes place at the Anaheim Convention Center in Anaheim, California, is far and away the biggest convention, showcase and schmooze-in for the music products industry in the U.S. The 1997 show, which took place January 16 – 20, brought together close to a thousand exhibitors displaying their wares and promoting their products.

Entry to the NAMM Shows is restricted to music industry types and press people. We arranged with Susan Rawcliffe, known to many of our readers for her beautiful, odd and exotic ceramic wind instruments, to attend the January show for a day as a reporter for *EMI*. The show is huge and Susan was only able to see a portion of it. Following here is her report on what she found.

Let us make no mistakes, this show is about money, not about music. The Anaheim convention center is packed from one hall to another. Din and desperation are everywhere. All the manufacturers both major and minor are there: Korg, Roland, Cerwin Vega, Baldwin Pianos, Emu, Remo, LP. Mostly, the show is electronic keyboards, winds, switches, percussion controllers, software and I don't know what all. You can wear your feet out. There were ear plugs; cases, straps, and wheels; musical instrument jewelry including Elvis watches; kazoos; whistles and more. According to Don Buchla and Richard Bugg, friends who know about electronics, there was nothing much of unusual interest shown. Richard said that he was intrigued that there were modular synths offered by a small manufacturer similar to the old analog ones.

Similarly in the acoustic world, I and my acoustic friends found nothing much of unusual interest. Several booths displayed collections of musical instruments from various countries including Africa and South America.

In the percussion world, there were several competent small drum manufacturers such as Akbar Moghaddam and his Sol Percussion congas of San Francisco. Mountain Rythym of Kaslo, B.C. Canada makes ashiko and djembe drums with an interesting twist peg for adjusting tension in the lacing. Remo had more of their excellent world drum line in contemporary materials, including new congas and some fun plastic fruit and vegetable shakers. Taos Drums is putting their Native American-inspired drums into a set-drum framework. In addition to their standard line, Latin Percussion had a new "Udder:" about four soft rubber hoses folded and tied in half with whistles in both ends, and played by waving it around in the air. Rhythms, of Sunnyvale, California, was selling somewhat crude-looking udu drums of both ceramic and metal, including ones with small membranes attached to the sides. Roundstone Musical Instruments from Galway, Ireland was offering "genuine goatskin Bodhrans." Trinidad and Tobago Instruments makes an array of pans. And Hardwood Music, Flagstaff, Arizona showed their well tuned tongue drums.

In the string world, the range of instruments included a hail of piano manufacturers including electronic versions of piano-roll pianos, classical and flamenco guitars, dobros, Irish harps, violins and more. In addition, Dr. Alfio Leone, a Sicilian luthier from Italy, offered his instruments; MasterWorks, of Arlington Texas, offered hammer dulcimers and psalteries; and Najarian Music, of Anaheim Hills, California, offered a range of beautiful-looking ouds and necessary accessories.

There was the usual range of wind instruments: white, pink and multicolored tubas and more traditional brass instruments, various clarinets and flutes and their mouthpiece manufacturers; and there were people building better reeds. Most interesting to me were the Mollenhauer recorders designed by Maarten Helder: they play three octaves and have a screw which adjusts the placement of the block of the fipple, thus changing the depth of the wind way and therefore the timbre. There were perhaps six didjeridu manufacturers; it seems to be one of the latest areas of egregious small-scale commercial endeavor. (It annoyed me immensely to see didjeridus with extremely lumpy, carelessly applied beeswax being sold to unsuspecting shoppers.)

This is just a selection of the manufacturers and products I saw and remember, or for which I obtained a brochure. Needless to say, I saw only a small selection of the NAMM 1997 show.

Susan Rawcliffe

A few more odds and ends of information: The show taking place in January each year is the Winter NAMM show. There is also a smaller annual NAMM Summer Session; this summer it is set for Nashville, July 11- 13. For 1998 and again in 1999, the big winter NAMM Show will move down the freeway from Anaheim to the Los Angeles Convention Center. Looking beyond the U.S., the major international music products show is the Musikmesse which happens annually in Frankfurt. This year's Musikmesse took place February 26 – March 2.

THE PEOPLE AT LONGWAVE INSTRUMENTS, makers of theremins and more, have recently come up with something new, and given it the name Little Infinite Frequency Expander, or LIFE. You can see it in the photo on the next page, surrounded by toy Star Wars characters and other miniature action figurines. From Longwave's press release:

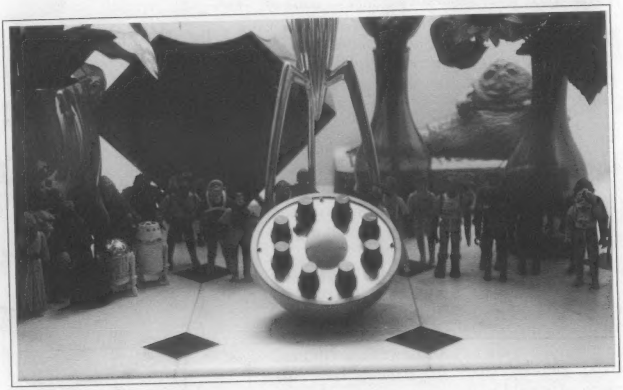
LIFE is essentially a compact, self-contained, hand-held inspirational tool for everybody interested in the creation of sound. It is difficult to describe the sounds that LIFE can produce; such words as organic, tactile, unexpected ... have been used. The wooden hemispherical base sits comfortably in either hand and

has been described as "sensuous to handle." There are eight interacting controls on the basic model which are used to shape the sound. Subtle movements of these controls create endless possibilities, strange spaces to explore, new textures to discover. The central dome pulsates in sympathy to the audio output with changing colors, forming the bond between sound and sight.

LIFE can be more than a "singular" source of inspiration. Many units can be linked together to generate complex polyrhythms, sonic backdrops — your imagination is the limit.

For more information, contact Longwave at 23 Ashley Lane, Hordle, Lymington, Hampshire SO41 0GB, England; phone 01 425 610849.

LIFE, from Longwave Instruments, surrounded by other forms of life.



EMI NO LONGER TO BE AVAILABLE AT MOST NEWSSTANDS

After the issue following this one, *Experimental Musical Instruments* will no longer be available at most newsstands. So if you've been picking up your copy of each issue at a newsstand, hey! Subscribe now, so we don't lose you.

EMI will continue to appear at certain individual retail outlets that have long carried us, as well as those news outlets served by the Tower distribution network.

For our ongoing listing of WEBSITES FOR UNUSUAL INSTRUMENTS, see page 28 of this issue.

CORRECTION: In the article "Alchemy in the Nineties: turning garbage into gold," by Jan Jarvlepp (*EMI* Vol. 12 #3, March 1997), the photo for Example 4, showing glass jars mounted in a wooden frame for percussion playing, appeared upside down. It's shown here in the correct orientation.

In his recent letter requesting a sample issue of Experimental Musical Instruments, the New York musician Peter Etcetera included a hand-drawn gallery of instrument ideas with accompanying commentary. Here are his drawings and notes:

PLEASE SEND ME A SAMPLE COPY of *EMI*; I have a serious interest in the unusual because I want to destroy the wall built between popular culture and the avant-garde and as an artist and musician I really loathe the segregation of mediums, cultures and genres in the U.S.

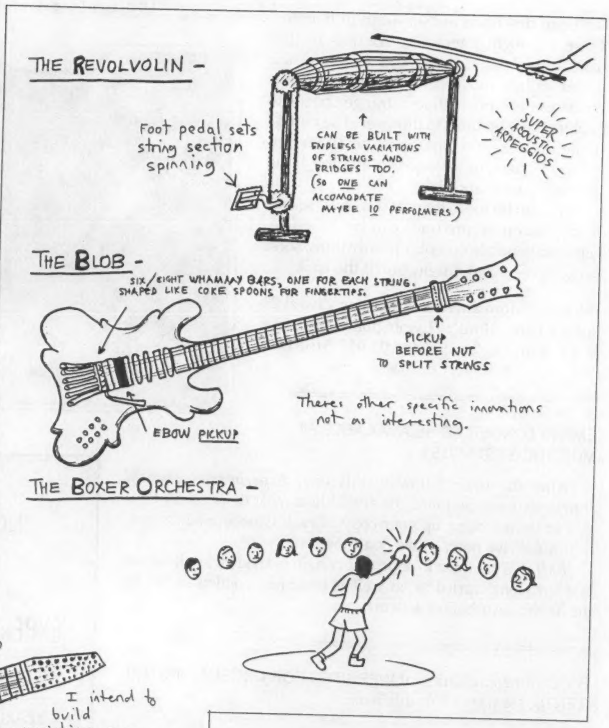
That's another thing that bothers me about the E.M.I. world: It's like rock musicians who do creative stuff in their *basement*, but then stick with the *traditional* once outdoors. One of my projects is a balloon power-trio (drums, bass, balloon) where the balloon takes the place of a wild guitar (and sax, I suppose). Ditto my theremin power trio. I like things blatantistic — unavoidable. In your face! Yummy!

The use of ordinary objects is swell, but doesn't it disturb you when artists take the easy way out sometimes? Discipline is usually good. Like I play Beethoven's 5th on a piece of corrugated cardboard because it's too easy to play *unconventional* music on unconventional instruments. I've got a piece called "Is John Zorn in my Sink?" where I simply turn on a faucet with a loose washer/gasket and so it sputters randomly. It sounds just like Zorn's typical sax spew.

I did a piece called "Wind Instrument Pop" which is just a duet for two blowdryers but it is pure catchy pop music. People hear it and are surprised that — hey! — the unusual can be pleasurable. Hey! Let's not marginalize everything that deviates from the norm. My composition "Bacon Bit" is written for frying pan frying, three acoustic 12-strings and two voices and it's totally legit as a pop song — if a tiny bit abnormal. (The lyrics are "I'm mistaken, 'cause I've forsaken bacon." It's a vegetarian lament.)

And then there's the problem of interesting instruments used in mediocre ways. The Chapman Stick? Oh, God, the poor thing! (I own one but it's up in Boston.)

Don't you agree that to reduce the theremin to imitating a violin is a crime?!



Anyhow, if my ego hasn't turned you off yet here's a few more things you can look forward to. (Maybe.)

An orchestra (?) of Revolvolins™

Just drop a violin bow on it and hear the violent arpeggios! I'm not sure if I'll be able to set up some kind of universal joint to allow changing the tuning *while* it's spinning, but I hope so.

The Blob guitar

Fred Frith and others have also done this, but I haven't heard it done right yet.

The Boxer Orchestra™

Surrounded by prosthetic heads as sample triggers, the performer (in boxing gear) creates mighty, physical symphonies. This piece was designed for my Artner, Mikey, who is a performance art-comedian/drummer/everything else.

50-String Guitar

Those harp guitars in the *Gravikords, Pyrophones and Whirlies* book look fun, but I think my 50-string guitars will be much cooler. Some will look like superzithers! *Huge racket!*

Feelaphonics Acoustisuit

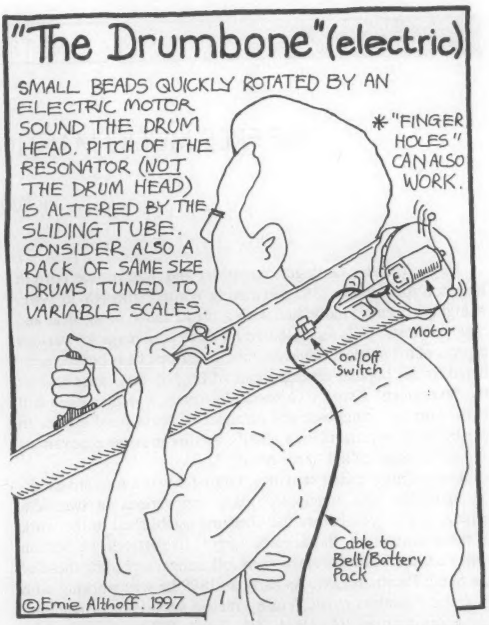
A body suit wired and lined with hundreds or thousands of electrodes that stimulate the flesh. Imagine feeling a symphony!

Danger Drumkit

All the drums are on swings or springed levers so when you hit it your rhythm better be good and fast.

Oh, re: Wendy Chambers' car horn organ, when I get into politics someday I plan on getting all the auto manufacturers to pick specific notes so in a traffic jam you'll get wonderful melodies. It'll be grand.

Peter Etc.



The Drumbone is part of a series of possible instruments by Ernie Althoff

DEMONSTRATION/WORKSHOP
by
TOM NUNN

VENUE 9
252 - 9th Street, S.F.
Sunday, May 18, 1:30-4:30 p.m.

Tom Nunn is known for his unusual, sculptural, sometimes creature-like musical instruments called Electroacoustic Percussion Boards and Space Plates. Tom presents a "tell all" demonstration/workshop, including:

- Discussion of various instruments displayed
- Why the instruments are suited to improvisation
- Tools, materials, supplies, resources
- Playing techniques described and demonstrated
- Amplification and processing
- Relationship between sound, image and ergonomics
- Future possibilities and multimedia
- Literature on experimental instruments and improv
- Hands-on participation -- informal interactions

Please call Tom at (415) 282-1562 to register.

COST: $15

THE FREE MUSIC MACHINES OF PERCY GRAINGER

by Rainer Linz

Percy Aldridge Grainger, composer and pianist, was born in Brighton Australia in 1882 and died in White Plains NY in 1961. A highly eccentric individual with a broad range of musical and other interests, he is remembered on three continents for various aspects of his musical achievements. In Europe he is best remembered for his popular arrangements of English folk tunes such as the "evergreen" *Country Gardens*. In America many people will know him as a composer and arranger of brass band music. In Australia he is remembered chiefly for his musical innovations and for what he called "Free Music."

Despite his populist activities, Grainger was a forward-thinking musician who anticipated many innovations in twentieth century music well before they became established in the work of other composers. In his early career, like Bartok, he was an active collector and documenter of folk songs, including those of the South Pacific region. As early as 1899 he was working with so-called "beatless music," using metric successions (including sequences such as 2/4, 2½/4, 3/4, 2½/4, 3/8 etc.) inspired by the irregular rhythmic patterns of speech. His use of chance procedures in *Random Round* of 1912 predates John Cage (!), and he composed "unplayable" music onto player piano rolls while Conlon Nancarrow was still a child.

Grainger first conceived his idea of Free Music as a boy of 11 or 12. It was suggested to him by the undulating movements of the sea, and by observing the waves on Albert Park Lake in Melbourne. These experiences eventually led him to conclude that the future of music lay in freeing up rhythmic procedures and in the subtle variation of pitch, producing glissando-like movement. These ideas were to remain with him throughout his life, and he spent a great deal of his time in later years developing machines to realize his conception.

Grainger explained his concept of Free Music in a letter to critic Olin Downes in 1942:

> In this music, a melody is as free to roam thru tonal space as a painter is free to draw & paint free lines, free curves, create free shapes... In FREE MUSIC the various tone-strands (melodic lines) may each have their own rhythmic pulse (or not), if they like; but one tone strand is not enslaved to the other (as in current music) by rhythmic same-beatedness. In FREE MUSIC there are no scales — the melodic lines may glide from & to any depths & heights of (practical) tonal space, just as they may hover about any 'note' without ever alighting upon it... In FREE MUSIC harmony will consist of free combinations (when desired) of all free intervals — not merely concordant or discordant combinations of set intervals (as in current music), but free combinations of all the intervals (but in a gliding state, not needfully in an anchored state) between present intervals...[1]

Clearly, Free Music is conceived of as melodic (polyphonic), making use of long, sustained tones capable of continuous changes in pitch. The term *glissando* does not adequately describe the movement of these tones, but may give a basic idea of the type of melodic line Grainger was referring to. A glissando is most often a performative device — its exact shape determined in performance — and no traditional form of notation exists to adequately describe one in fine detail. Most early scores making use of glissandos describe them as a straight line between two notes of unequal pitch. Their direction of movement tends to be either up or down, much more rarely up *and then* down, for instance. More recent scores, especially those consisting mainly of glissandos, can be more specific.

Grainger's reference to rhythm is an interesting one, since sustained tones are not usually thought of as having rhythm. It is doubtful that he was referring to articulation or simple dynamic variation. Grainger's own scores were originally notated on graph paper, with an individual trace for both the pitch and dynamic changes of each note. If a conventional rhythm were to be notated in this way, it would mean bringing the dynamics fairly often down to zero — turning off a note in order to begin the next, and so articulate a rhythmic sequence. Yet Grainger's dynamic shapes are aligned more to the phrase than the individual note. How then is a rhythmic pulse achieved?

One answer lies in the pitch domain. The pitch undulations in a moving line serve to articulate rhythm by their change of direction or by a change in the *rate* of movement. Nothing in traditional music theory prepares us for this fundamental relationship between pitch and rhythm, which goes some way toward explaining why Free Music has remained misunderstood for so long, and perhaps why other composers have been slow to take up the challenge of Grainger's conception.

Harmonically, too, Free Music questions the tenets of Western musical practice by assuming a moving tone, precluding any harmonic stability. In this context, a "stable chord" is perhaps one where all parts are moving in a fixed parallel relationship to one another. Yet by definition in Western harmony, this is a "changing chord" because the fundamental is in motion. Working with this material can be a vexatious undertaking for the composer, since almost every basic assumption about musical relationships and method is called into question.

Grainger considered Free Music to be his only lasting contribution to music. Yet what remains after his death is a collection of short score fragments, a few experimental recordings, and a number of prototype machines built for the purpose of realizing his ideas.

Grainger resorted to the use of machines because it was apparent that human performers on traditional instruments were

not capable of producing what he required. Although some traditional acoustic instruments are able to produce "gliding tones" — instruments like the trombone and violin — they do so within comparatively narrow ranges, and the necessary control over minute fluctuations of pitch is difficult to achieve.

Nor were the available electronic instruments suitable for his purpose. Many of those developed before the 1950s tended to be keyboard-based and thus wedded to the chromatic scale. Others, such as the theremin, lacked a means of subtle and consistent control. While more complex instruments, such as the RCA synthesizer developed by Harry Olsen during the 1950s, showed more promise, it was also apparent that Free Music worked against their inherent design principles; that it would be necessary to force them into something that they were simply not designed to do.

It should also be understood that Grainger's machines were not intended as performance devices. Rather, they were composing machines designed to allow Grainger to hear with his ears those sounds he heard in his head. Grainger was meticulous on this point. He insisted on hearing his compositions before allowing them to be published, and often went to extraordinary lengths to secure the means of having his more experimental work realized.

Grainger's early experiments involved modifying existing instruments, enabling them to approximate gliding tone characteristics. The "Butterfly Piano," for example, was tuned in sixth tones so that scalar passages played on it would give a closer approximation of gliding tones than a traditionally tuned piano. Grainger was not interested in microtones as such, since his idea meant the abolition of the scale; his goal was a controlled continuous glide, and microtones were quite literally just a "step" towards this end.

A number of other experiments were carried out in collaboration with physicist Burnett Cross. Cross has described[2] connecting three electronic keyboard instruments called Solovoxes — tuned a third of a semitone apart — by means of string to a piano keyboard to achieve similar ends. This experiment, while demonstrating some feasibility, ultimately proved unsatisfactory since one of the Solovoxes invariably produced a different tone quality than the other two, and the instrument constantly played triplets!

Having decided that modifying existing instruments would not lead to satisfactory results, Grainger and Cross embarked on a project of designing and building special purpose machines. One of these, the Reed-Box Tone-Tool, might be described as a giant harmonica tuned in eighth tones. This was a largish (table-top) instrument constructed of wood, and containing harmonium reeds. It was "played" by passing a perforated paper roll, similar to a player piano roll, across the front of the instrument and applying suction from a vacuum cleaner to the rear. While having the look and character of a home-made instrument it nevertheless produced, according to Grainger, the first accurately specified and accurately produced gliding chords in the history of music.[3] This instrument, along with several of the others described here, is on display at the Grainger Museum in Melbourne.[4]

Another machine, the Oscillator-Playing Tone-Tool[5] built in 1951, is based on a Morse code practice oscillator, called a Codemaster, which was available at the time. This oscillator had a continuously variable pitch range of some three octaves, adjusted by a control on the front panel. Grainger's sketch of November 1951 shows a hand drill mounted on a Singer sewing machine, connected in such a way that the piston of the sewing machine was able to turn the handle of the drill. The shaft of the drill was fixed onto the Codemaster's pitch control. In this way, turning the wheel of the sewing machine altered the pitch of the oscillator.

Perhaps the most famous of Grainger's Free Music machines is the so-called "Hills and Dales" machine, described in a sketch of 1952 as the "Kangaroo Pouch method of synchronizing and playing eight oscillators." This machine, which is exhibited in the Grainger Museum, consists of a large wooden frame approximately eight feet tall, housing upright rotating turrets left and right (the "feeder" and "eater" turrets) and between which a large paper roll is wound. This roll consists of three layers: a main paper roll 80 inches high, across which eight smaller horizontal strips of paper (or subsidiary rolls) are attached front and back. The top edges of these subsidiary rolls are cut into curvilinear shapes ("hills and dales") and attached to the main roll at their bottom edges, each forming a type of "pouch." As the turrets are rotated clockwise, the undulating shapes cut into the rolls move from right to left.

Eight valve oscillators are mounted onto the wooden frame, four at the front and four at the back, as are eight amplifiers. The pitch controls of the oscillators are attached to levers, connected at the other ends to circular runners, or spools, which "ride" the moving rolls. The volume controls of the amplifiers are operated in the same way. Thus, the pitch of the oscillators, and the volume of the amplifiers, can be accurately controlled by carefully cutting shapes into the paper rolls. The large dimensions of this machine were necessary to maintain accuracy of pitch control — an error of one eighth of an inch in the height of the paper roll's curve did not significantly affect the pitch of the oscillator. Yet the machine was not without its problems. As the valves in the oscillators aged they changed their characteristics, and the machine needed careful recalibration after as little as three hours of use.[6]

The final machine, uncompleted at the time of Grainger's death in 1961, was perhaps the most sophisticated. It too worked on the principle of a moving roll, but this time made of clear plastic. Here, a row of spotlights projected light beams through the plastic roll and onto an array of photocells, which in turn controlled the pitch of the oscillators. The familiar undulating shapes, so carefully cut into the paper rolls of the Kangaroo Pouch machine, could simply be painted onto the plastic roll with black ink. Moreover the circuitry for this machine was transistorized, lending a stability which could not be achieved with the use of valves.

Unfortunately, the machine was lost in transit between Grainger's home in White Plains and the Grainger Museum in Melbourne during the 1970s. Nor did Grainger have the chance to compose with this machine, so we can only speculate about the music he would have created on it.

This leaves us with something of an enigma. Although we can form a reasonably clear conception of Grainger's intentions, Free Music remains essentially an abstract, unrealized idea. Yet the implications of this idea point to nothing less than a total renovation of Western music; to far more radical concepts than Schoenberg's 12-tone method, for example.

Grainger's search for a means to realize Free Music was frustrated by a lack of substantial resources and by the limitations of available technology. Despite the recent advances in electronic instrument design, the question posed by Burnett Cross still bears some careful consideration: are the means of realizing Free Music available today?

ENDNOTES

1. From *A Musical Genius from Australia* Ed Teresa Balough, Perth Aus 1982 p141.

2. In a lecture given at La Trobe University in Melbourne in 1982.

3. These chords can be heard on the *Leonardo Music Journal* CD, accompanying issue 6, 1996.

4. The Grainger Museum is located at the University of Melbourne, Parkville, Victoria 3052, Australia.

5. A sketch of this instrument is reproduced on the cover of *Leonardo Music Journal*, Vol 6 1996.

6. A recording of this machine can also be found on the *LMJ* CD.

Rainer Linz is an Australian composer and performer whose work includes electronic, instrumental, vocal and music-theater compositions. For ten years he published the new music journal NMA *(New Music Articles), and is co-author (with Jon Rose) of* the pink violin *and* Violin Music in the Age of Shopping, *and* Arias - Recent Australian Music Theatre *(with John Jenkins). He has designed interactive sound systems for performance artist Stelarc, and he performs regularly on a computerised music instrument (based on the Sensorlab) of his own design. He currently lectures in composition at La Trobe University in Melbourne.*

SIRENS, Part One

By Bart Hopkin

This is Part One of a two-part article on sirens set to appear in this and the following issue of *Experimental Musical Instruments*. This installation focuses on basics — what sirens are and how they work — as well as history. Part Two will deliver practical information on the making of sirens as mucial instruments.

Prior to the appearance of the jet engine, the man-made sound source with the greatest capability for sheer volume was the siren. Because of that characteristic, sirens have been used primarily as signaling and warning devices, such as air raid alarms and fire engine alerts. But sirens have a significant and colorful role in the history of acoustic theory. They also have unexploited potential for music-making; and they don't have to be piercingly loud.

As an acoustical device, a siren takes what would otherwise be a continuous flow of air and converts it into a series of pulses. These pulses, occurring at some frequency within the hearing range, propagate out into the surrounding atmosphere as sound. In its simplest form, the heart of the siren is a rotating disk. The disk is perforated around its perimeter with a ring of evenly spaced holes. A narrow air stream is directed against the disk through a tube in such a way that the holes pass as closely as possible in front of the tube's open end. In the moments when one of the holes passes in front of the tube, a puff of air passes through. Between the holes, the air flow is momentarily blocked by the surface of the disk. The puffing frequency corresponds to the rate at which holes pass in front of the air-supply tube. That frequency is the disk's number of rotations per second times the number of holes — for instance, a disk with a ring of 44 holes rotating at 10 revolutions per second will produce an audible tone at a frequency of 440Hz, or A above middle C.

The siren can thus be seen as an air-gating device. In this respect it is related to reed instruments. Consider the harmonica, which has metal reeds of the sort that are called free reeds. Within the harmonica, the reed at rest blocks a small air passageway. Under the pressure of the player's breath, the reed momentarily flexes out of the way to allow a puff of air through; then springs back to block the passage again; then flexes away again, and so forth, effectively converting the steady flow of the player's breath into a series of puffs at some audible frequency. Both the siren and the harmonica can be classified as "interruptive free aerophones"[1] — the "interruptive" referring to the air-gating approach, and the "free" part referring to the fact that they typically are open-air instruments, without flute-like resonant air tubes or chambers.

Models of the very simple siren just described (a rather quiet instrument, incidentally) were made and used by a number of 18th and 19th century researchers in acoustics. It is an engraving of this very instrument that holds the place of Figure #1 in the most important of 19th-century acoustics texts, Hermann von Helmholtz' famous *On the Sensations of Tone* (*Die Lehre von den Tonempfindungen*, 1877. See the figure overleaf.) But the basic idea — that of an air flow rendered as an audible series of pulses by means of a perforated rotating element — has over the years taken many forms. Let us step back now and review the history of sirens, insofar as it is known.

According to several secondary sources,[2] the invention of the siren mechanism can be credited to the 18th century Scottish natural philosopher John Robison (1739-1803). Helmholtz makes no mention of Robison in *Sensations of Tone*, but describes the simple siren in his figure as being "after Seebeck," without further explanation. Presumably the reference is to the German physicist Thomas Johann Seebeck (1770-1831). In a slightly later acoustics text, J.A. Zahm also refers to a similar device as "Seebeck's Siren" (Rev. J.A. Zahm, C.S.C., *Sound and Music*, 1892 — a wonderful book).

The name *siren* (French *sirène*) seems to have been given by the French engineer Baron Charles Cagniard de la Tour (1777-1859). It was de la Tour who came up with the reconfiguration which converted the rather quiet instrument of Seebeck and Robison into a sound producer of great power. He did this by means of an enclosure and a double-disk system. We have fine illustrations of the idea from both Helmholtz and Zahm (Figures 2 and 3, overleaf). Here's how the de la Tour siren works: The air under pressure is directed into an enclosure. The front of this enclosure is something like a typical siren disk, with a ring of holes around the periphery, but this disk is fixed (not rotating). Directly in front of this is a second disk, with identical hole spacing. This second disk rotates. When in the course of rotation the holes in the two disks are aligned, then all holes simultaneously allow air to pass. When the holes move out of alignment, all the holes close and no air passes. To cause the outer disk to spin, its holes can be drilled obliquely, at something like a 45 degree angle. The air rushing out then drives the disk in a manner similar to a turbine or windmill. (The effect can be increased by drilling the holes on the stationary disk obliquely in the opposite

1. This terminology comes from the widely used Sachs-Hornbostel system for the classification of musical instruments.

2. Sources for historical information on sirens are few. Most of the information in these paragraphs is gleaned directly from Helmholtz and Zahm, augmented by Hugh Davies' article on sirens in *The New Grove Dictionary of Musical Instruments* (London: MacMillan Press Ltd. and New York: Grove's Dictionaries of Music, 1984) and, to a lesser extent, some other general-knowledge sources.

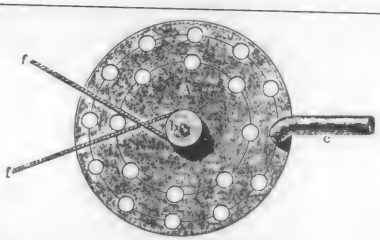


FIGURE 1 (left): Simple siren "after Seebeck," from Hermann Helmholtz' *On the Sensations of Tone*. The part labelled *c* is an air tube.

FIGURE 2 (below): Three views of an enclosed siren with rotation-counter mechanism, from Helmholtz. Two of the views are cutaway views, showing the inner workings.

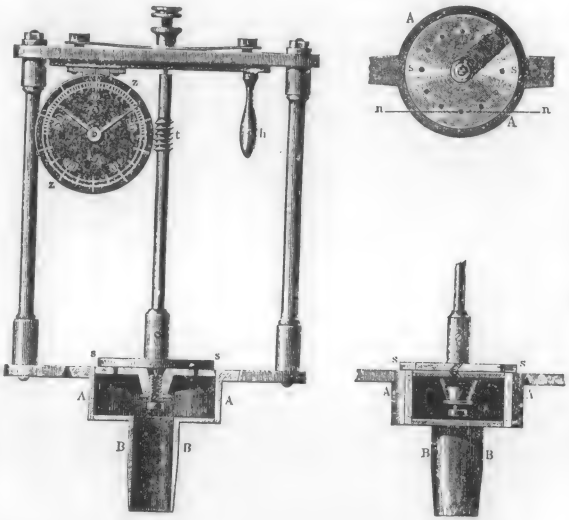
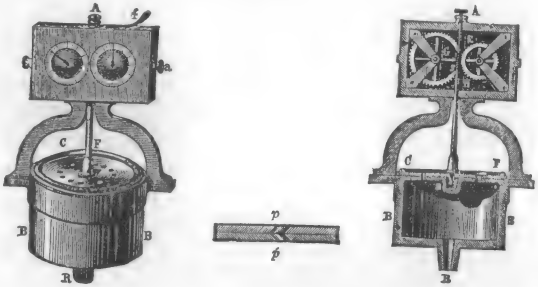


FIGURE 3 (below): Another enclosed siren with rotation counter, depicted in Pietro Blasema's *The Theory of Sound in its Relation to Music.*



direction.) With this arrangement, air pressure alone is sufficient to operate the siren; no external driver for the disk is required. The mechanics of this air-drive system explain the rise and fall of the wailing sound we associate with sirens even today: as the air flow causes the disk gradually to accelerate, the audible frequency rises. This system, with its double disk and enclosure, is far louder than the simple siren for two reasons. First, it multiplies the effect by providing a large number of holes emitting pulses of air simultaneously instead of just one. Second, it eliminates cancellation problems that are inherent in the simpler design. This takes a bit more explaining, and I'll go into it more fully later on.

Another significant early innovation in siren design was the appearance of multiple rings of holes. Helmholtz credits this development to one Dove, apparently being the German meteorologist Heinrich Wilhelm Dove (1803-79). The idea is to have several concentric rings of holes, with different numbers of holes in each ring (Figure 4 and 5). Each ring will then provide a different pitch: while a ring of 44 holes in a disk rotating at 10 rps will produce a tone at 440Hz, a smaller concentric ring of just 22 holes will yield a tone an octave lower at 220Hz. In a de la Tour siren, all the rings typically sound simultaneously, producing a chord made up of intervals determined by the ratios of the numbers of holes in the rings. (Alternatively, each ring could be given the same number of holes, thus further reinforcing the single tone.) But in simple open siren with multiple rings of different numbers of holes, you can select which tone will sound by directing the air stream at different rings. In the early sirens the number of rings, and thus the number of pitches available, typically was two or three or four. But with enough rings of different numbers of holes, you could have an instrument capable of playing a more complete scale.

There was a reason that sirens played such a prominent role in Helmholtz' teaching, and in other experimental and pedagogical work that followed. The early sirens served physicists and professors as an effective tool for observing, demonstrating, conceptualizing, controlling and measuring sound in the air. As a rudimentary example, what else could more convincingly illustrate the idea that sound is a matter of rapidly recurring pressure pulses in the atmosphere?

Of particular importance was the siren's role as a frequency counter, providing researchers with a convenient method for counting vibrations per second, and clearly

demonstrating the relationship between the physical phenomenon of frequency and the perceived phenomenon of pitch.[3] To work in this fashion, the researcher needed to know how many times the disk had rotated in a known time period. As shown in Figures 2 and 3, sirens depicted in early pedagogical books are often equipped with rotation counters operating by means of clockwork-like mechanisms — intriguing examples of 19th-century mechanical ingenuity.

Helmholtz took matters further when he had the double siren shown in Figure 6 built. The two sirens, which face one another, have identical disks and operate on a single drive shaft, so that they normally spin at the same rate and are capable of producing identical tones. The two siren casings and their disks can be aligned so that their rings of holes open and close at the same time, producing a strong sound. But the casing for the upper siren, including its fixed disk, can be slowly rotated in a controlled fashion by turning a crank. If the upper siren is rotated just the right amount and left in that position, it can be set so that, while operating at the same frequency, its holes close just as the lower siren's holes open, and vice versa. The two sirens are then out of phase; the instant of maximum pressure for each pulse from one coincides with the instant of minimum pressure from the other. They cancel, and the sound becomes weak. Thus, another essential concept in acoustics was made observable, demonstrable controllable and measurable — the concept of phase relationships. And more: by turning the crank continually so that the fixed disk on the upper siren rotated slowly even as its rotating disk spun rapidly below it, Helmholtz was able to slightly alter the frequency of the upper siren. This situation, with the upper siren sounding slightly detuned relative to the lower one, gave rise to the phenomenon known as beating — the wavering rise and fall in volume that comes about when two sources of near but not identical frequency sound together. The relationship between beating and phase relationships was thus convincingly demonstrated in a manner easily observed and conceptualized.

Using the double siren, Helmholtz also demonstrated underlying principles of just intonation. Central to the study of just intonation is the idea that for two or more tones sounding together, consonant harmonies arise when the frequencies of the tones form simple proportions — e.g., frequency ratios such as 2:1, 3:2, or 5:4 tend to strike the ear as consonant, while more irregular ratios involving larger numbers seem more dissonant. In the siren disk with its several rings of different numbers of holes, the proportional relationships are laid out for all to see. For example, whatever the speed of rotation, an outer ring with 44 holes will always produce twice the frequency of an inner ring of 22 holes on the same disk, for a frequency ratio of 2:1, corresponding to the musical interval of the octave. And, of course, one can hear the actual effects when the siren sounds.

Another area for early exploration had to do with the sizes

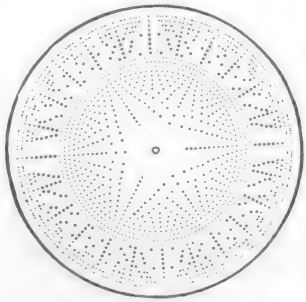
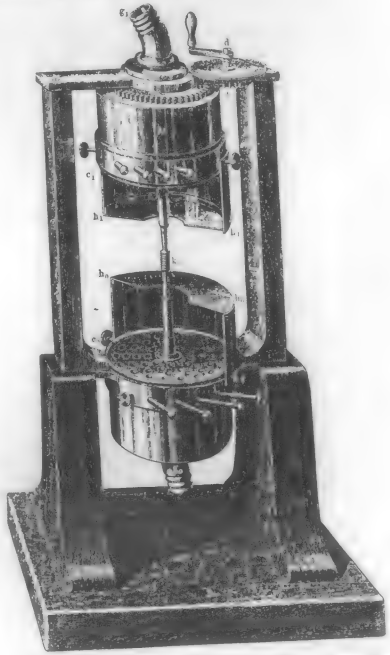


FIGURE 4 (above left): A siren with many rings of holes, depicted in J.A. Zahm's *Sound and Music*.

FIGURE 5 (above right): An unusually elaborate siren disk containing 24 rings of holes, depicted in Zahm and credited there to an acoustician named Oppelt.

FIGURE 6 (below): Helmholtz' double siren. Notice that there is an outer casing (cutaway in this drawing) over the two disks. This was to create an air resonance chamber to enhance the lower frequencies and make the upper partials less strident. Notice also the four bolt-like components protruding from the side of each siren. These were the manual controls for an elaborate internal mechanism that allowed the sounding of one ring of holes at a time by selectively blocking or un-blocking the air flow through each of the individual rings.



3. In this connection, Helmholtz notes that, prior to the use of sirens, "The exact determination of the pitch number [frequency] for such elastic bodies as produce audible tones, presents considerable difficulty, and physicists had to contrive many comparatively complicated processes in order to solve this problem for each particular case." [From Alexander Ellis' 1885 translation of *On the Sensations of Tone*, Dover Publications, Inc., New York, 1954.]

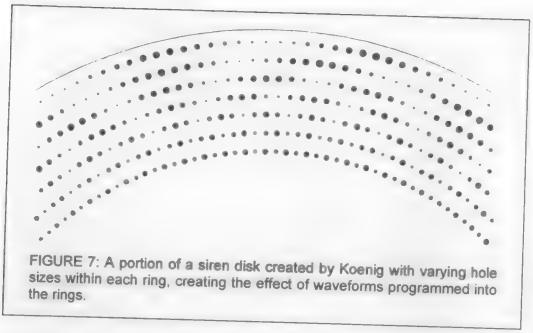


FIGURE 7: A portion of a siren disk created by Koenig with varying hole sizes within each ring, creating the effect of waveforms programmed into the rings.

of the holes within each ring. Karl Rudolph Koenig (Prussian acoustician, 1832-1901), created a disk of seven rings in which the holes were not uniform in size within each ring, but appeared in regular patterns of larger and smaller holes (Figure 7). With such a ring, one hears not only the frequency of the total number of holes within the ring, but also lower frequencies associated with the periodic appearance of larger holes. The higher frequencies can then be heard as overtones of a lower-frequency fundamental. It would be impractical, but taking the idea further it's not hard to imagine extraordinarily elaborate disks using gradations in hole size to create something analogous to what today might be called digital wave forms.

Following this line of thought, Koenig went on to develop another variation, the wave siren. Several of these appear in Figure 8. The wave siren design is not well suited to de la Tour's enclosed, double-disk approach; it would typically take an open form like the simple disk sirens, and would probably, like them, produce a weak tone. In the wave siren, there is no ring of holes; rather, the outer edge of the disk has a wavy shape. Air flow from a tube is directed against this edge. As the waves rise and fall in front of the tube, they alternately block and unblock the flow through the tube opening much as the holes in other siren disks do. An advantage of the wave siren is that it is relatively easy to deliberately create different sorts of wave forms in the edge of the disk. The shape of the disk's wavy edge, in theory, corresponds to the wave form of the resulting acoustic signal. By cutting disks to different edge shapes it should be possible to create a siren sound with, for instance, what acoustics people call a sine wave, or a square wave, or a sawtooth wave. For a variety of reasons, I suspect that the correspondence between the disk shape and the actual resulting acoustic wave forms would not be close as one might wish. But it should at least be true that by experimenting with different disk edge shapes, you could come up with different tone qualities from the siren.

I mentioned earlier the turbine-like system by which the force of the air alone can cause the siren disk to turn, eliminating the need for a separate rotational driver. It turns out that this situation can be reversed as well. If a siren has a motor to drive the disk, then the rotation of the disk can be used to propel the air, eliminating the need for a separate air source. One way to do this is to add tilted blades or baffles to the surface of the rotating disk, extending over the holes, to propel the air like the blades of a fan. Helmholtz made brief reference to this trick in the first appendix to *Sensations of Tone*. (In the same appendix he also describes a primitive electric motor with speed control for driving the disk.)

In this century, many warning sirens have been made with rotating cylinders rather than rotating disks. In this configuration, a perforated cylinder rotates within a stationary housing provided with a matching set of perforations. Their operation is much like disk sirens: they can be driven by compressed air, or they can employ motor-driven rotational motion to force the air. Typically, however, the openings are not small holes, but windows made rather larger, since the larger opening area contributes to a louder sound.

I managed to get a look at one of these cylindrical warning sirens at a local fire station. It was mounted behind the bumper of one of the big trucks, and I had to lie on my back under the truck to view it, but I was able to see it well enough to confirm that it did conform to the principles of siren design I had been reading about. It consisted of an electric motor in a housing about 8" long and 4" in diameter, driving a rotating element of about 8" diameter and 4" long, set within a cylindrical outer housing with the required window-shaped openings. The rotating element was designed (so I surmised) to drive the air not by means of baffles, but by centrifugal force, in effect whirling air out through the windows in the outer casing.

Traditional acoustic warning sirens such as this, referred to as "growlers" one fireman told me, are considered old fashioned by people in fire-prevention and law enforcement. In recent years most of them have been replaced by purely electronic sound makers. This was confirmed for me when I got hold of a sales catalog entitled *Audio Alerts and Alarms* from a company called Projects Unlimited. It contains fifty pages of audio warning devices for industry and law enforcement, and every one of them is entirely electronic in operation. Most of them employ piezo-electric transducers as the noise-producing element. Some are programmed to produce an electronic version of the familiar siren's wail.

True acoustic sirens are still made today, but on a more humble scale. Small sirens appear occasionally in children's toys, for instance. My son at one point had a small toy airplane with a tiny mouth-blown siren housed in it. It was simply and roughly made, but it worked, with the familiar rising wail. A couple of people have spoken to me of a type of siren that was made, years ago, to go on a child's bicycle. It had a drive mechanism that pressed against the bicycle's rear wheel as it turned, thus activating the disk and stimulating the air flow. As an attention-getter, I'm told, it was quite effective.

In vaudeville and silent film days, a mouth-blown siren was one of the essential items in the sound effects person's trick bag. The small, high-quality mouth-blown sirens are still made by the Acme company in England, which produces a variety of other fun sound effects as well. The Acme Siren takes the form of a cylindrical stainless steel enclosure, two inches long and a little under an inch in diameter. Inside is a stationary disk with a small, freely rotating disk directly in front of it, each containing six

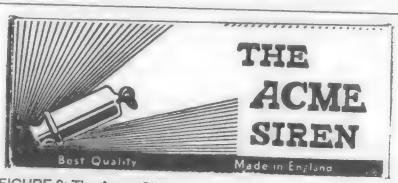
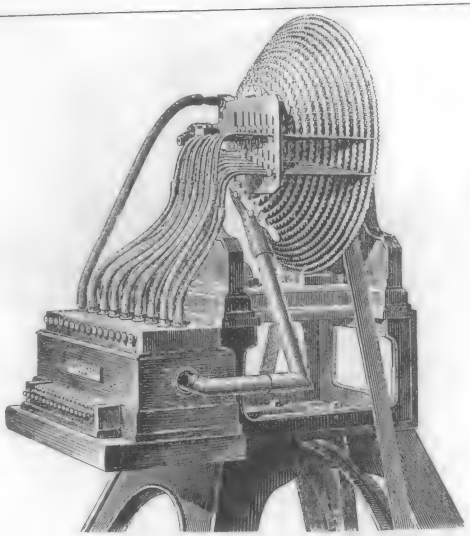
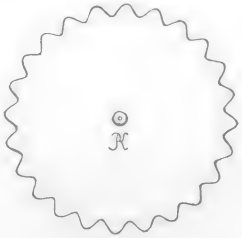
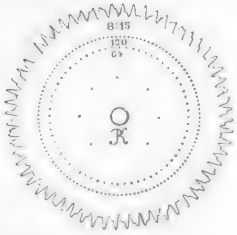
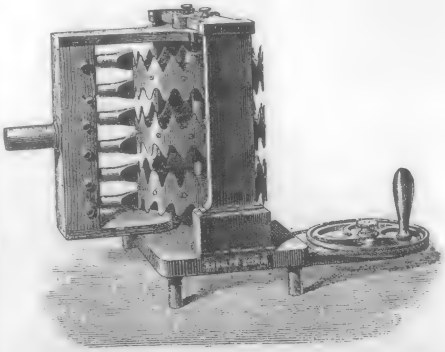


FIGURE 9: The Acme Siren, as depicted on the box it comes in.









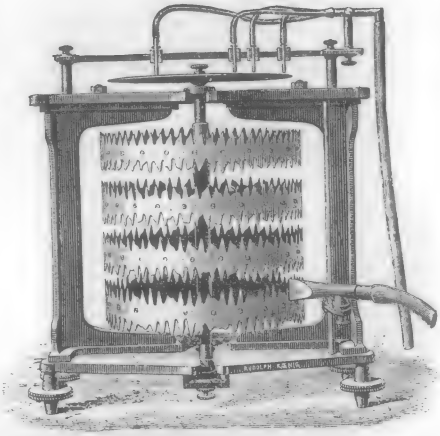


FIGURE 8: Several variations on wave sirens and siren disks by Koenig, all depicted in Zahm's *Sound and Music*. In a wave siren it's not possible to have multiple tones in a single disk. At the upper left you can see a solution to this limitation: an elaborate wave siren with a total of 15 disks, providing a complete scale of some sort. It's provided with stationary tubes directed at the edges of the disks and a keyboard-like control console. The disk edges appear to be shaped in something close to a sine wave form.

The two drawings in the upper right show individual wave siren disks, one with a sine-wave shaped edge and the other with a more complex wave form.

The two drawings below show wave sirens in a new configuration: they have wavy-edged cylinders in place of disks. (We will see more of the cylinders idea as the article progresses.) The instrument on the left has six possible tones — but notice that the cylinder edges all seem to have the same number of equally spaced waves, meaning that, spinning at the same rate, all will produce the same fundamental tone. Yet they have different wave forms — some pointed and some rounded. The instrument appears to have been designed to compare the tone qualities resulting from different wave forms at the same fundamental pitch. The drawing on the lower right shows a similar instrument with more complex waveforms. In addition to the cylinders, this instrument also has a regular siren disk mounted on top.

holes. The holes in the rotating disk (which is about 1/8" thick) are drilled obliquely so that the air flow activates the spinning. It works great — the sound is unmistakably siren-like, and respectably loud for something so small, though, of course, nowhere near as loud as a full-sized siren.

Another variant of the siren that has arisen in the twentieth century is the light siren. Light sirens are not wind instruments and perhaps should not considered true sirens, but the conceptual parallels are strong. A light siren is a sound instrument having a rotating disk set between a light source and a photoelectric cell. The disk may have rings of holes or slits to let light through, or it may made of transparent material printed with concentric patterns in opaque pigment. As the disk rotates, the holes or transparent portions let light through, while the opaque portions block the beam. The on-off-on-off of the periodically interrupted beam on the photoelectric cell creates an alternating current which can be sent to an amplifier and speakers. Hugh Davies, in his article under the heading "Electronic Instruments" in the *New Grove Dictionary of Musical Instruments*, lists quite a number of such instruments that have been built since the early part of the century, some of them quite sophisticated. The most exciting work today comes from the French maker Jacques Dudon,[4] whose Photosonic Disk is a marvel of engineering and art: complex, mathematically derived patterns of opaque ink computer-printed on transparent disks give rise to music of extraordinary richness and subtlety. The player controls the sound output simply by moving a hand-held light so as to bring different parts of the disk into play.

If we can step back for one more moment to the 19th century, I'll describe one more peculiar siren variation, the heat siren. This is another of the exotic scientific devices described by J.A. Zahm in his 1892 treatise, *Sound and Music*. Zahm gives it the name *radiophone*, and credits it to one M. Mercadier. The device, shown in Figure 11, employs a gas jet or electric lamp serving as a radiant heat source. With the aid of a concave reflector, the heat is directed at a typical rotating siren disk with concentric rings of holes. On the other side of the disk is a small brass tube covered with lamp black. Zahm explains: "Through the perforated disk on the rotator, intermittent flashes of heat ... are allowed to impinge on the soot-covered brass tube. This, by producing rapid changes in temperature, causes corresponding expansions and contractions in the metal tube, and a continuous sound follows in consequence." In the version shown in the drawing, a horn, seemingly coming off of the top of the brass tube, reinforces and directs the sound, yielding "notes that can be perceived at a considerable distance from the instrument."

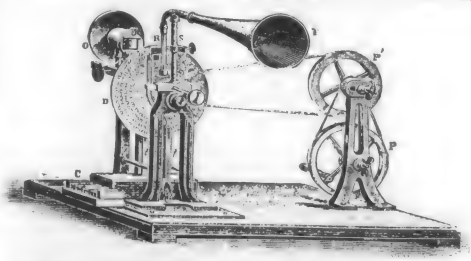


FIGURE 11: The radiophone, a heat siren, credited to M. Mercadier in Zahm's *Sound and Music*.

In this discussion thus far I've said relatively little about sirens as musical instruments. That's because sirens have only rarely been used for musical functions. In most cases when they have been used in music, the instrument called for has been a signaling siren been brought in for special effect. The idea that sirens could be designed specifically as musical instruments, with a range of pitches to be controlled by a player, has been explored only minimally.

So I took it upon myself, a few years ago, to make a siren expressly as a musical instrument. My design was based upon the simple sirens shown at the start of this article, with the single exposed rotating disk and a blow tube, with many rings of holes to provide a range of pitches. More recently I built another musical siren with a slightly more sophisticated design. I learned a lot in making the two of them, and in Part 2 of this article, set to appear in the coming September issue of *Experimental Musical Instruments*, I'll try to pass some of that information on.

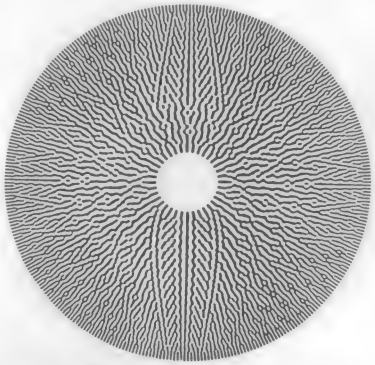


FIGURE 10: A light siren disk from Jacques Dudon's Photosonic Disk. This is one of many that Jacques and his colleagues have created. Each disk, imprinted with different patterns, has its own distinctive musical characteristics.

4. For more on Jacques Dudon's work, see Tom Nunn's article in *EMI* vol. III #5, as well as the section devoted to him in my recently published book *Gravikords, Whirlies and Pyrophones*. Sounds of the Photosonic Disk are featured in Jacques Dudon's CD *Lumieres Audibles*, available from Atelier d'Exploration Harmonique, les Camails 83.340 Le Thoronet, France.

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Hermann L. F. Helmholtz; translated by Alexander J. Ellis, *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (New York, Dover Publications Inc., 1954; originally published by Longmans & Co., 1885)

The Rev. J. A. Zahm, C.S.C., *Sound and Music* (Chicago: A.C. McClurg & Co., 1892)

Special thanks to Reed Ghazala for bringing the Zahm book to my attention and making it available to me, and likewise to Craig Tucker for the Blaserna book.

THE CAT'S CRADLE

50 strings, 82 pickups and two amplifiers

By John Gzowski

I came into instrument building through necessity. As a guitar player I was never very happy with the twelve-tone equal temperament tuning system that we conventionally use. No matter what I did I could never get major thirds to sound in tune. They were always sharp, especially bad inverted as a tenth (major third plus an octave). If I got one chord to sound in tune than all others would sound even worse. Then one day I was mucking about with a synthesizer that had some limited retuning abilities. It was able to play something close to 19-tone equal temperament, and I was enthralled. After asking some questions a friend suggested I read Hermann Helmholtz'19-century treatise on acoustics, *On the Sensations of Tone*, which I did and was excited by the possibilities discussed there.

Since then I have built a 19-tone equal-temperament electric guitar out of an Ovation Breadwinner guitar that I bought as a teenager. I pulled the frets out of it, had it refretted, and had twenty small autoharp-like strings installed in the body. I added four piezo-electric pickups, the round door-buzzer kind, in different places on the instrument. (Piezo-electric pickups are pickups which work as contact mics, converting the vibrational movement of the body to which they are attached directly into an electric signal which can be sent to an amplifier.) The best sounding one was sandwiched in between the neck and the body. I was really happy at the end result, and have since used it in four or five groups, a couple of CDs and even in a pop tour. But I realized I wanted to be able to build a better instrument for alternate tuning systems. With the 19-tone guitar I was stuck with only the one tuning system, and I wanted to be able to check out some more.

To fill this desire, I came up with the stringed instrument that I'll be describing in the remainder of this article: the Cat's Cradle. The Cat's Cradle can be seen as having two parts. One is a fret board with a set of strings over it, which the player plays in a manner somewhat akin to electric guitar and other fretted string instruments but with important extended techniques. The other is a set of additional strings which are not actively played, but which respond sympathetically to the frequencies from the played strings on the other part of the instrument. The sympathetic strings add a wash of resonance and reverberation to the overall sound. While the instrument's sound comes entirely from the strings, the Cat's Cradle uses unusual electro-magnetic techniques to activate the strings and color their sounds, as you'll see as the article progresses.

John Gzowski with the Cat's Cradle
(for a full-sized reproduction of this photo, see the front cover)

I am not a carpenter or luthier, but fortunately a guitar player friend of mine was a carpenter and even worked for a luthier who also worked as a cabinetmaker. They both agreed to help out with cutting and shaping of the larger pieces, making sure that I didn't make a total mess out of it. With access to good tools and some technical support assured, I went to work.

The design takes elements from some existing instruments. The playing part is based on a Chapman Stick* but modified to suit my purposes. The active string length was increased to a very long 37.5". This makes it possible to use small intervals without the spaces between the frets being too small to play effectively. I wanted one continuous set of ten strings (as opposed to the Chapman Stick's two sets of five) so I ended up having to use a tuning of major thirds between the open strings, going from the lowest A on a piano to an A just below the B string on a guitar. This was as high as I could get with commercially available strings.

I had heard of Mark Rankin's interchangeable fretboard system and had written to him to get the details. With Mark's system you can create multiple fretboards, each with different fret spacings allowing the instrument to play different, nonstandard scales and intervals. When you want to play in a particular scale, you affix the appropriate fretboard over the neck and under the strings of the instrument; when you want another scale, you can quickly and easily remove that fretboard and replace it with another. The system uses magnet fretboards

*"The Chapman Stick is the electrically amplified, 10-stringed, fretted instrument created by southern California builder Emmet Chapman. It is designed for playing not by plucking or bowing, but by using both hands on the fretboard in the string-tapping technique that guitarists call "hammering on." The name "stick" reflects the fact that its shape is that of one long, stick-like fretboard — by analogy to the guitar, it's as if it's all neck and no body.

Above: Removable fretboard.

Below: Detail of the Cat's Cradle's pickups and sustainer.

which stick on a piece of steel on the neck. Mark sells the materials to build the fretboards in kits, comprised of a base of rubberized magnetic material, which is glued to a piece of non-magnetic alloy. The frets are designed with a flat base and are glued directly to the alloy surface, with a couple layers of cosmetic lexan for finish. They work quite well and can be put together with a minimum of tools. (For more information, you can try to contact Mark Rankin at P.O. Box1464, Redway, CA 95560. Be patient; he travels often and is sometimes hard to reach.)

I designed my fretboard around the maximum size possible: 30" by 3". The playing part was built from one piece of maple (local and good wood). I put in two truss rods for stability (two way adjustable truss rods purchased from Stewart-MacDonald's Guitar Shop Supply [800-848-2273], which were then extended by a machinist to reach the 30").

The long string length was to be an important design element of the Stick-like part of the instrument, but it caused me quite a few problems. To use commercially available tuning pegs meant I would lose about 5 or 6 inches of string length in post winding and increased neck length. The longest electric guitar strings were only 40" long, and even these were hard to find. I realized I would have to work out my own string tensioning system. I had two pieces of brakeline (brakeline is a bronze alloy standard car part; it is a tube usually about four feet long and 1/8" in diameter) brazed together side by side lengthwise by the same machinist, which I then cut into 1/2" pieces. Each piece was threaded on one side. I cut slots big enough for the brakeline to move unimpeded straight through the stick-thing at the bottom. A plate with two holes for each string was attached to the bottom of the stick. I could then use a #6 machine screw to loosen and tighten the strings, using the ball end of electric guitar and bass strings which would not pass through the breakline. At the top end of the neck I had a piece of ½" by ½" steel cut, with holes drilled through the top and sides. The top holes were threaded, and using set screws to clamp down the strings I had my own locking nut.

For pickups I had hoped to use commercially available models, but after installing a pair of P-bass replacement pickups (standard size commercial bass pickups; the P is for Fender Precision models) I found they did not have the proper string spacing and would not pick up the outer pair of strings. After a bit of looking around I found someone in Toronto who could wind pick-ups but wouldn't produce bobbins for the winding. So I went to a place that sold industrial magnets, bought some alnico magnets (which are nearly impossible to cut) and with some old pole pieces from a cheap pickup I had lying around I set out to make a bobbin. I ended up using record vinyl, which was about the right thickness and easy to work with, for the top and bottom. The pickups were wound successfully, but the vinyl melted a little as they were waxed. I think next time

I might use thin baltic ply. These pickups were much better than the commercial ones, with pole pieces directly under each string. (For more on pickup winding procedures, including definitions of some of the terms used here, see Steve Ball's article "Electromagnetic Pickup Design and Construction Techniques" in *EMI* Volume 10 #1, Sept. 1994.)

I had decided early on that I wanted to see if I could design my own infinite sustain system, similar to an E-bow. An E-bow is an electric guitar accessory for controllable sustain that operates like a guitar pickup working in reverse: the output from a conventional guitar pickup is sent through an amplifier and back to the E-bow, which is hand-held over the strings. The E-bow works electro-magnetically to drive the strings, recycling their own frequency back to them, thus perpetuating the vibration and giving them indefinite sustain. I bought an E-bow and pulled it apart to try to see how it worked. Don't ever do this! I didn't learn anything I didn't already know and destroyed the E-bow at the same time. I don't know much about electronics, so I ended up finding an approach that worked in my particular application by trial and error. I created a sustainer by winding magnet wire (#25 I think) around a piece of steel long enough to cross all the strings perpendicularly. I placed strong neodynium magnets on the bottom of the coil, away from the strings. The amplifier puts out alternating current, so the coil will alternately put out a north then south magnetic charge. The string will not be able to tell the difference between north and south and will be attracted on both halves of the waveform cycle. The magnets cancel out the north charge so the strings only see half of the charge, but at the original frequency. I fed the output from the pickup into a small guitar amplifier, and used the signal from the speaker output jack of the amplifier to drive the sustainer. Using a volume pedal before the amplifier I was able to control the amount of sustain from none to infinite. It was a surprisingly simple and effective thing to build. It took a few tries before I got it right, but the parts were cheap and relatively plentiful.

The second element of the Cat's Cradle is the frame with forty sympathetic strings that gives the instrument its name. I had always wanted to be able to get the kind of resonance a piano player can get with a sustain pedal, and had wanted to be able to make the sound of the instrument much richer than a slab of wood with strings would be. The frame is in the shape of a tetrahedron. The forty strings are arranged in twenty cross-modulating pairs, parallel to the floor. By "cross-modulating," I mean that the pairs cross and touch in the middle to make them a little more inharmonic. I did this because I didn't want forty notes to jump out and all others to not sound.

In acoustic instruments with sympathetic strings, the sympathetic strings are excited by their proximity to the main strings. Whenever the main strings sound at a frequency that is shared by one of the sympathetic strings, the sympathetic string joins in the vibration adding a sort of reverberant wash to the tone. The sound of the sympathetic strings is fairly quiet. For the Cat's Cradle, I wanted more from the sympathetic strings, so I felt I needed an active system to excite them. Originally I had planned to make twenty small amplifiers to drive twenty small electromagnets, but another system was suggested. Instrument maker Garnet Willis had borrowed from composer James Tenney a record of Alvin Lucier's *Long Wire* project, and thought that the system that Lucier used in that recording might work for the Cat's Cradle. It was a process in which an alternating current (AC) was fed through a long wire which is mounted like a long, vibrating string. A stationary magnet was placed near the string. As the current induced an alternating magnetic field around the wire, the string was forced to move magnetically. After a few tests I wired all of the Cat's Cradle's sympathetic strings into one long string (total resistance about 10 ohms) and placed neodynium magnets under the ends of the strings. The signal from the main strings on the Stick-like part of the instrument was fed into a 100-watt amplifier and from there through the sympathetic strings, causing them to respond to the frequencies from the strings on the Stick-like part. Then, in order to pick up and amplify the sounds of the sympathetic strings. I placed piezo pickups under each end of each of them.

The frame itself was cut out of two dowels, 40" long and 2" wide. I calculated the angle at which the strings would have to cross, then traced a line along the dowels from one end to the other, using a flexible tape measure. The dowels were then pulled through a bandsaw twisting them as they came through along the line carefully so as not to break the bandsaw blade. This gave me two mirrored pieces which could be routed and drilled for the strings. The same brakeline tuning system was used with bolts to stop the strings on the opposite side. The four half-dowels were attached with hinges so the frame would fold up enough to fit in my car with a folding middle support to keep it in position when opened. It is a little messy, as the strings just collapse as it folds, but it works well enough. The folding and unfolding change the tuning of the sympathetic strings but that doesn't matter as they don't have to be tuned to specific pitches to work effectively.

The instrument is very successful; it does what it is supposed to and more. The interchangeable fretboards are easy to change and not impossible to make. The sustainer is quite easy to control with a volume pedal and the sympathetic strings add a rich resonance to the sound. Once I had it all working and plugged in I was quite surprised to find that the pitch of the sympathetic strings would rise and fall as I played. I realized that as the current is put through the strings it heats up them up, at the same time causing them to expand and drop in pitch. This reaction happens quite quickly and adds even more color to the sound. When I sustain a note I hear overtones ring in the sympathetic strings, then as they heat up they change pitch and no longer resonate, but then a new overtone will. It creates a very lovely effect. My only problem is that the instrument has been fairly hard to learn to play, what with the different tuning systems and different technique required, but I have been getting better on it. I have used it in a number of concerts and recordings, most recently in a nationally broadcast concert of microtonal music by Critical Band with guest musician Johnny Reinhard.

John Gzowski is a musician/instrument builder/composer/sound-editor from Toronto Canada. He has worked in pop, jazz, world and new music groups. Currently he is the leader the microtonal ensemble Critical Band. He can be reached at 846 Bloor St. W. Toronto, Ontario, Canada M6G 1M2 or through e-mail at John_Gzowski@goodmedia.com

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THE LOOP GROUP BRASS

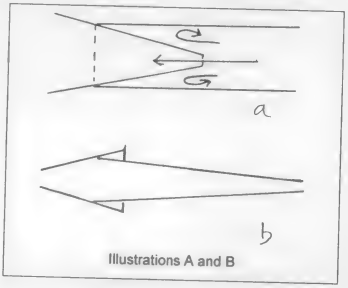
by Ray Wilding-White

Richard Hunt is a leading American metal sculptor. He works out of an abandoned power sub-station on Lill Street in Chicago whose cavernous space, complete with a working overhead crane, makes it perfect for the large pieces he creates. For a period I lived close by and we became friendly.

When the Conn instrument factory in Elkhart, Indiana closed its doors, a large quantity of parts of brass instruments were sold to a jobber who, in turn, sold them to Hunt, who acquired them in order to salvage the metal. With his kind permission, I sorted out a number of pieces, some of them bent into interesting shapes. In co-operation with the tuba player Charles Shallcross — who also became the project's tester — we assembled parts into into combinations that appealed to us audially and visually. Hunt then lent us the services of his welder who welded the pieces into solid units.

I was the president of the Loop Group new music ensemble and the group promptly put the horns to use. The most striking quality of the horns was their theatricality and we therefore exploited this trait by "choreographing" the performances in various ways. Sounds were improvised by the players in manners that seemed to fit both the nature of the horn and the stage actions.

For example, being over twelve feet long, the Texas Longhorn would bend if not supported; thus it was played by a short person and the front end was supported on the shoulder of a tall person giving a Mutt and Jeff effect; slow stately entrances from behind something seemed to take forever and, being one of the horns that produced the standard harmonic series, send-ups of traditional fanfares seemed appropriate. Unfortunately no record, audio or video, was kept.



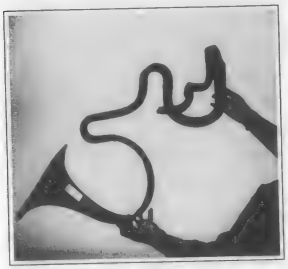
Illustrations A and B

When I retired and moved to Wisconsin, Loop Group closed shop after twenty years of bringing new music to Chicago. Not having space or use for them in my Kewaunee home, I sent the horns to Stuart Dempster, long known for his avant-garde trombone work, at his office at the University of Washington in Seattle. Dempster, however, was now into different things and so he gave them away to Rhoda Evans, a performance artist who showed genuine interest in them. Sad to say, Stu lost track of her and the horns. (Hello out there Rhoda

CORNE DE SABOT

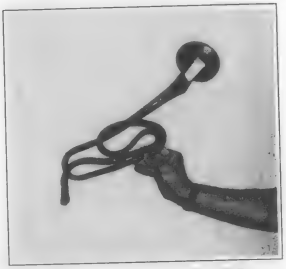
BULGARIAN WOLFHORN

CYCLOPHONE



TUBA MIRUM

TRICORNO NAPOLITANO



TROMBE L'OEIL DE PICARDIE

Evans, if you read this, drop me or Stu a line.)

Some of the horns do not produce the standard harmonic series. Back pressure is produced by bent pipes or by jamming one conical section into another and creating a "dead end" (illustration a). The strangest results occurred when different bores were joined, particularly when conic sections were reversed (illustration b).

I gave the horns fanciful names. Seven are shown here both in a group shot and individually.

1. CORNE DE SABOT (Alsatian Shoehorn) D A D F# D

2. BULGARIAN WOLFHORN B*b* G $B_{\flat}$ D E-F# G# B*b*

3. CYCLOPHONE This was only partly made of Hunt fragments. It was a bicycle handlebar with bell and mouthpiece tubing added and three bicycle bells attached. $B_{\flat}$ F $B_{\flat}$ $E_{\flat}$ A B C. Bells F F#G

4. TUBA MIRUM (Played with the bell pointing back over the shoulder) B F# B F# B D F

5. TRICORNO NAPOLITANO (The "Tricorno" was the three pointed hat of De Falla fame.) The horn was three trombone bells jammed into each other. C_3 C G C E $B_{\flat}$ C

6. TROMBE L'OEIL DE PICARDIE G D G B D F G A B

7. TEXAS LONGHORN G_3 D G B F G—C

A note on the photographs: If the pictures appearing here are not of the highest quality, it is because they have been reproduced from a set of photocopies, which are the only available visual documentation of the instruments.

TEXAS LONGHORN

Ray Wilding-White is a composer of over a hundred works from electronic pieces and chamber works to choral and symphonic compositions, widely performed by prominent ensembles and in noted venues. He has also been active as a promoter of new music, as a jazz pianist and arranger, and as a photographer.

THE SOUND ART OF ROBERT RAUSCHENBERG

By Mike Hovancsek

Robert Rauschenberg is one of the most well known artists in American history. Known by some as the "Father of Pop Art," his experiments in print technology (using silk screening, lithography, solvent transfers, photography, and a huge assortment of other techniques) are well documented in museums around the world. He is legendary for his dense, politically charged collages and his challenging sculptural works. One aspect of his creative output that may be of particular interest to *EMI* readers is his sound-producing and sound-activated work.

In 1953 Rauschenberg was at a fairly early stage in his career. He had been spending a lot of time with influential artists like John Cage and Merce Cunningham, each of them developing the ideas that would change their respective mediums forever. In between his experiments with minimalistic painting techniques, Rauschenberg constructed "Music Box." This piece was a wooden box that had several antique nails driven into it. Three small stones were placed inside. When the box was shaken, the stones would tumble around on the nails, producing a series of sounds. Upon shaking "Music Box," artist Marcel Duchamp told Rauschenberg "I think I've heard that song before."

In 1956 Rauschenberg created "Broadcast," a painting that included three working radios. He was interested in developing this idea further by making a series a paintings that could produce sounds that viewers could control.

Rauschenberg began collaborating with sound technician, Johan Kluver, in 1962 in order to explore the technical possibilities of interactive art. He asked Kluver to help develop a "painting as orchestra" in which the viewers would be the conductors of the resulting events. The work of these two men eventually developed into a 1965 sculptural installation entitled "Oracle." "Oracle" consisted of a bathtub into which a continuous spray of water streamed, a car door that was attached to a typing stand, a window sash, and a curved air vent. A series of radios reproduced a real-world cacophony as motors randomly rotated the tuning dials, effectively creating a random sampling of radio broadcasts. Viewers were able to interact with "Oracle" by manipulating the volume and rate at which the radios scanned across the dial.

Later that year, wanting to further his collaborative efforts and to expand on the possible benefits of combining technology with art, Rauschenberg created "Dynamic Labyrinth." This project was a combination of five sculptures that were constructed out of industrial materials. Five artists, including Jean Tinguely and Niki de Saint-Phalle lent their technological talents to the project. Sound elements included an electric pump that forced air into a tank of water and clocks that ran at different speeds.

In 1966 Rauschenberg composed a multi-media theater piece entitled "Open Score" with the cooperation of a team of technicians from Bell Labs. The sound-oriented portion of the piece featured a multi-media tennis match. Each time the ball was struck, a loud "pong" sounded and one overhead light was extinguished. The piece ended when the final light was extinguished and the performance area lapsed into complete darkness.

Rauschenberg and his technicians utilized the latest technology in this piece. FM transmitters built into the tennis balls transmitted the sound of the racket/ball contact onto the arena's loudspeakers and activated switches that extinguished the lights. An infrared, closed-circuit television was also used to show projections of onstage activities.

Driven by the desire to create art that "would be responsive to people viewing it" and in which no two people would have the same experience, Rauschenberg and a team of technicians from Bell Labs developed "Soundings" (1968).

"Soundings" was made up of a series of nine smoked plexiglass panels. Viewed in silence, the piece appeared to be nothing more than a large, smoked mirror. As the audience moved around the room and made noise, however, various portions of the piece were illuminated, revealing a series of silk screened images of straight-backed chairs. The piece responded differently depending on the timbre and tone of the individual's voice. As a result, Rauschenberg explained, "Everybody sees his own work of art by speaking to it."

In 1971 Rauschenberg worked with the Teledyne Corporation to develop "Mud Muse." Taking a break from the flashier works he had been doing, Rauschenberg wanted to engage his audience on a "basic, physical level." "Mud Muse" was a large vat of industrial drilling mud that bubbled and spurted in response to auditory signals. An assortment of pre-recorded sounds (including bird songs, musical notes, and machine noises) as well as sounds made by the audience triggered events in the installation.

Taking the interactive spirit a little farther than intended, the audience at the gallery opening scooped up the mud and smeared it on the gallery walls, causing the curators to shut down the show (much to Rauschenberg's chagrin).

As the above-mentioned projects indicate, Robert Rauschenberg spent his entire career experimenting with a number of approaches to creative expression, often utilizing and developing new technologies in the process. In the course of his work, Rauschenberg encouraged others to explore the possibilities of combining art and technology. Many pieces that have been featured in the pages of *EMI* owe something (directly or indirectly) to his ground-breaking work. Readers are encouraged to look farther into the career of this influential artist, numerous books and articles having been published over the years.

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Hansen, Alfred E. *A Primer of Happenings and Time/Space Art.* New York: Something Else Press, 1965.

Ashton, Dore. *The Unknown Shore: A View of Contemporary Art.* Boston: Little, Brown, and Company. Atlantic Monthly Press, 1982.

In *EMI*'s September, 1996 issue (Vol. 12 #1), we ran an article by Geary Thompson titled "The Quartal System: The Introduction of the Two-Dimensional Keyboard." In the article, Geary talks about the possibilities for two-dimensional pitch arrays in keyboard instruments — that is, keyboards made up not of a single line of black and white keys, but rather several rows and columns of keys or buttons. Such arrangements have potential advantages in the fingering patterns, pitch conceptualization and use of space. Geary draws an analogy between the pitch layouts implicit in the fingerboards of fretted instruments and the two dimensional keyboard arrays. One of the most practical arrangements, he suggests, are "quartal" layouts — arrays in which the pitches ascend by semitones from left to right along the rows, while they ascend by fourths moving up the columns. An existing model for this is standard tuning for electric bass, with frets spaced a semitone apart and strings tuned a fourth apart.

In the article that follows here, Niles Hokkanen picks up the discussion. He notes that, in addition to the fretted instruments analogy, some of this territory has been explored quite fruitfully in the world of button accordions. Take it away, Niles ...

TWO-DIMENSIONAL KEYBOARD PATTERNS

by Niles Hokkanen

For any fretted instrument, the pitch layout of the neck could be extrapolated into a keyboard or pedalboard layout. But in most cases, the tunings would lose their instrument-specific (i.e. old-time banjo, open-slide guitar) benefits. One couldn't really transfer D-A-D-G-A-D or the Martin Carthy guitar tuning (C-G-C-D-G-A) onto a pedalboard and duplicate the ringing open strings and such. In extrapolating from the fretboard to keyboard or pedalboard, it makes more sense to go with a symmetrical pitch arrangement such as tuning in 4ths (ala electric bass guitar) or perfect 5ths (cello, violin, mandolin, etc.).

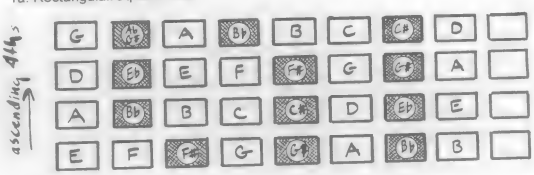
For a two-dimensional board, three types of grid layouts seem most promising: 1) square/rectangular, 2) diamonds, and 3) 60° equilateral triangular (though the buttons can be round as on accordions). The square/rectangular layout is great on fretted instruments, but once the thumb is on the fretboard keyboard style, slanting the vertical rows on a diagonal probably has fingering advantages (though virtuoso Appalachian dulcimer players might disagree).

It should be understood that this particular discussion is restricted to 12-tones to the octave, as in conventional piano, though one could always tweak the tunings from equal-temperament to another tuning. My personal interest lies primarily with foot-controlled pedalboards in the bass register for the purpose of playing bass-lines with one foot. The conventional one-octave organ-style pedalboard can do quite a lot, but having an expanded range of two octaves or so would really open up possibilities. Also, a two-dimensional layout cuts down on the amount of distance the foot needs to travel for larger intervallic jumps.

The first set off illustrations (Figure 1a - c) show a quartal (electric bass) layout in the three grid types. On the accordion-style grid (figure 1c), an extra

FIGURE 1: QUARTAL SYSTEM
(Layouts in ascending fourths)

1a: Rectangular/Square Grid



1b: Diamond Grid

1c: Equilateral Triangle Grid (fifth row added on top)

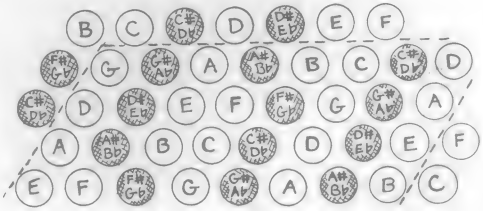


FIGURE 2: Layout in ascending perfect fifths

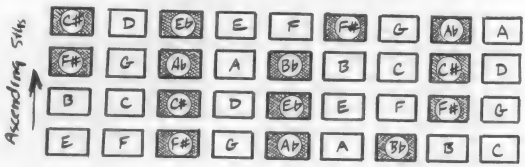


FIGURE 3: Left hand (bass) keyboard for piano accordions and chromatic 5-row accordions

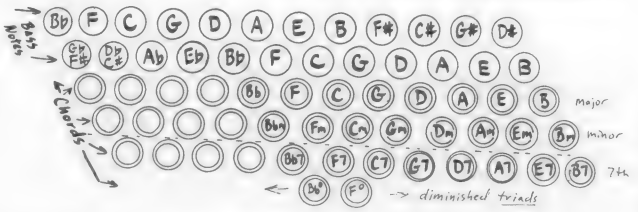
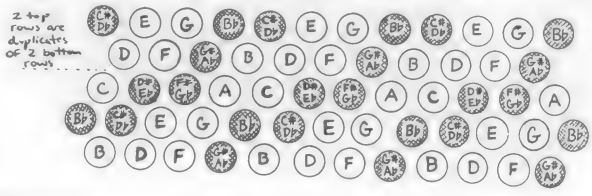


FIGURE 4

Compact bass pedalboard

FIGURE 5: Five-row chromatic "B-system" keyboard



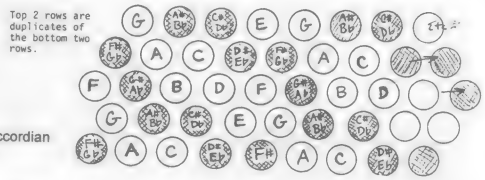


FIGURE 6

Five-row chromatic accordian "F-system" keyboard

horizontal row has been added on the top (high end of the register), as well as a few extra buttons to fill in the unused space cause by the 60° diagonal slant.

Figure 2 shows a 9 x 4 (horizontal x vertical) layout in perfect 5ths (vertical rows), à la cello, mandolin, or violin. E was used as the lowest note for comparison to the quartal grids, though C (as on a cello), D, or G (mandolin/ violin) could just as easily been used.

Two-dimensional keyboards are essential to the accordions, concertinas, bandoneons and other free reed instruments. We will not consider here the two- and three-row diatonic accordions which produce two different pitches on each button (one on the open, another on the close), nor the English-style concertinas and the bandoneons (which, while producing the same pitch in both bellows directions, alternate scalar notes from one side to the other). This leaves us with the bass side of the piano accordion (also chromatic) and the right hand (treble) keyboard of the 5-row chromatic accordion.

Figure #3 shows the bass button side of a five-row or piano accordion (the 'Stradella bass-system'). In the largest, most expensive models, there are six rows of 20 buttons. Beginner student models might have as few as twelve buttons (one row of six bass notes and one row of 6 major chords), but the minimum for general usage is a 48-bass (four rows of twelve) which gives you all twelve major and minor chords, plus two rows of bass notes. The 80-bass (five rows of sixteen) duplicates some of the vertical rows, and adds a row of seventh chords on the bottom. (The 120-bass, six rows of twenty, has a row of diminished triads below the seventh chords). This keyboard was designed for easily playing simple chord progressions and root-fifth bass lines. The top row of bass buttons puts the major third above the chord root. The bass notes are within one octave (A-G#) with the same note being duplicated on the top row.

A possible bass foot-pedalboard could be extrapolated by adding another row so that the vertical row (left to right going upwards) descends chromatically (see Figure 4).

You only need three rows of five to get all twelve chromatic notes (with three duplicated), but by extending the board horizontally on one or both sides, duplicating a few more notes, any long jumps between root-fifth are eliminated. With the horizontal rows stacked in fifth intervals, this layout would be quite easy to play on music with simple bass lines, such as bluegrass.

While you'll see mostly piano accordions in the USA, in northern Europe the chromatic five-row models are far more numerous. These have large round, white and black buttons on the right hand (treble) side. Once you examine the keyboard layout, you'll realize that this is a superior system. Horizontally, the notes are arranged in rows of diminished seventh chords (ascending minor third intervals) rising through a range of almost three or four octaves, depending how expensive the accordion. Vertically the rows are arranged in half tones (descending to the right) and whole steps (ascending to the right). This is the "B- system" (B is the lowest note), shown in figure 5.

There's another five-row layout which is essentially an upside-down version of the B-system, shown in Figure 6. Again, the horizontal rows are diminished sevenths, rising in pitch from left to right. The top two rows duplicate the notes of the bottom two rows. Vertical rows ascending towards the right go up in half step intervals.

Fig #7 shows the top three rows of the B-system for two octaves and a second. This would make a good foot-bass pedal board. This arrangement requires the player to learn only three different fingering/keyboard patterns for the major scales. Because of the symmetrical layout, the pattern for all the major scales rooted on the notes of the C-row are the same. The second pattern starts with a root note on D-row, and the third pattern begins on a top-row button. With five rows (the lower two duplicating the top two, in keeping with the pattern), then any major scale, regardless of the root, can be played with any of the three patterns. And, of course, the same goes for minor scales , etc. You'll also notice that the triads fall under the fingers in convenient geometric shapes.

I wondered how horizontal rows in major thirds (augmented chords) would lay out. This would require four rows before duplication would set in, or seven rows vertically (four original and three duplicates) before complete symmetry would be achieved. (The idea of complete symmetry is that by duplicating the rows, any of the original four rows can function as the "bottom" row [or the top row], so that geometric scale or chord patterns can be duplicated, regardless of the root note.) Figure 8 (with chromatics ascending diagonally downwards to the right) and Figure 9 (with chromatics ascending diagonally upwards to the right), show the two possible configurations. (The fifth row in the layouts shown duplicates the bottom row). Though potentially usable, this major thirds layout doesn't appear to come close to the five-row (diminished horizontal rows) layout for fluid fingering. However, as a foot-bass pedalboard where only one note is played at a time, it might be serviceable, especially when the available horizontal space on the floor is limited, as it takes only seven pedals to reach the second octave, rather than nine with the five-row chromatic layout.

Actually, from a practical playing perspective, any foot-driven bass pedalboard needs to have some three-dimensionality, with the bottom row closest to the floor and each row going back terraced slightly above the preceding one. (The black keys of a piano are set above the white keys; a third row would be set slightly above and behind the black keys.) See Figure 10.

Though white/black keys/pedals aren't a necessity, in lieu of position markers as on a guitar or bass guitar, they do serve as a visual reference.

FIGURE 7: Horizontal rows of diminished 7th chords (minor 3rds) ala five-row chromatic accordion

FIGURE 8: Horizontal rows of augmented chords (major 3rds). The top row duplicates the bottom row.

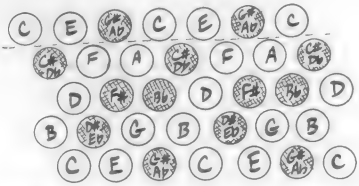


FIGURE9: Altermate augmented layout.

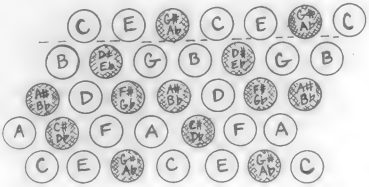
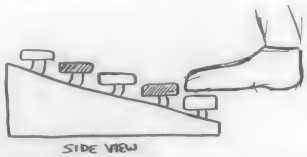


FIGURE 10: Pedalboard with multiple rows, one above another.



I haven't touched on the subject of how the sounds are actually produced — whether through MIDI, metal reeds, hammered strings, etc. Physical construction difficulties associated with different sound-producing mechanisms might eliminate certain keyboard/pedalboard layouts. But perhaps this short article has given you some ideas to work, or extrapolate, from.

(more) →

A FEW MORE THOUGHTS

After giving additional thought to the English concertina and diatonic accordion layouts mentioned only briefly in the sixth paragraph of the article above, I've begun to think that these systems could be adapted to two-footed bass pedal operation. With the diatonic accordions, you could think of the notes produced by closing the bellows as one keyboard, and the notes produced while opening them as the other keyboard. With the English concertina, each button sounds the same pitch on both the press and pull, but the notes of the C scale alternate between the left and right hand buttonboards. If you look at Fig #11, you'll notice that the white notes of the piano are in the center two rows (vertically), zigzagging upwards in intervals of thirds. The black notes are set off to the side on the outside rows.

Adapting this type of layout/scheme for foot use (Fig. #12), we'll flip the arrangement on its side so that the ascending direction is now left to right, rather than down to up. We'll divide the pedalboard into 2 sections — left foot, and right foot. Once again, in order to play a C major scale, one has to alternate between the 2 feet. Now what is the advantage of this layout, for two-footed playing, over the traditional 2 or 2½ octave Hammond organ piano-style pedalboard? Well, we've got almost a three-octave range. And much greater speed is possible by using both feet. The monster Hammond B-3 players use both feet, but it would seem to require a lot of cross-stepping; with separate pedalboards for each foot, getting tangled up isn't nearly as likely.

Nothing says that one would have to program such a pedalboard for only the bass register. Putting it in the midrange with a marimba or vibes voice might work quite well. Or synth horns... It may be possible (well, all things are 'possible' with enough practice) to play rip-roaring single line solos.

FIGURE11: 48-Key Treble English Concertina

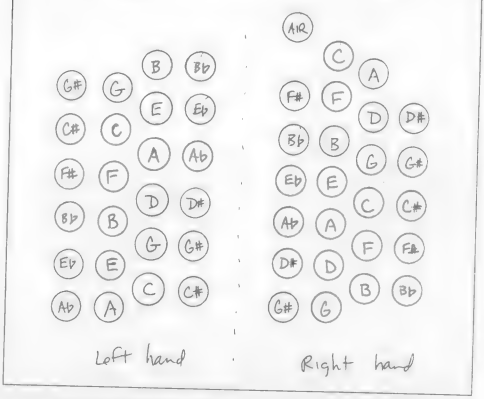


FIGURE12: Alternating (foot) bass pedal layout

Niles Hokkanen (b. 1952) is on the progressive cutting edge of mandolin playing in the USA. He is the author of numerous mandolin instruction books/tapes, and has recorded with cajun fiddler Michael Doucet, harmonica monster Howard Levy, and Appalachian dulcimer experimentalist Jerry Rockwell. His On Fire & Ready! cassette touches on the entire spectrum of roots music. Niles has published The Mandocrucian's Digest, a magazine for mando-family musicians, since 1986, as well writing for numerous music magazines including Acoustic Guitar, Strings, Acoustic Musician, Fiddler, Frets, etc.

He now plays a one-octave set of MIDI bass pedals (left foot) and a drum kit of his own construction/assemblage (bass drum, snare, small tom, hi-hat, three cymbals, cowbell) with the right foot. "The challenge is to continually up the complexity of both feet without having to dumb down the mandolin playing. Syncopated R&B and funk grooves are particularly a bear, as there are three completely different interlocking rhythms going on. But, I don't want to just be the Hendrix of the mandolin; I'd like to be the whole experience."

Niles Hokkanen can be reached at P.O. Box 3585, Winchester, VA 22604 (phone 540-722-9429). He also plays Scandinavian folk music in a band, Nordika, with his wife Deborah (keyboards, fiddle, piano accordion).

WEBSITES RELATING TO UNUSUAL MUSICAL INSTRUMENTS

The following is a short list of instrument-related sites on the world wide web that have come to *EMI*'s attention recently. Many more are listed in previous issues of *EMI*.

Musicians and Instrument Makers Forum (still under construction but coming soon): http://www.mimf.com

microMegas — an online magazine on topics relating to microtonality: http://www.teaser.fr/~daschour/micro.html

Hosaphone (site devoted to a form of flexible tube trumpet): http://www.roth-music.com/hosaphone

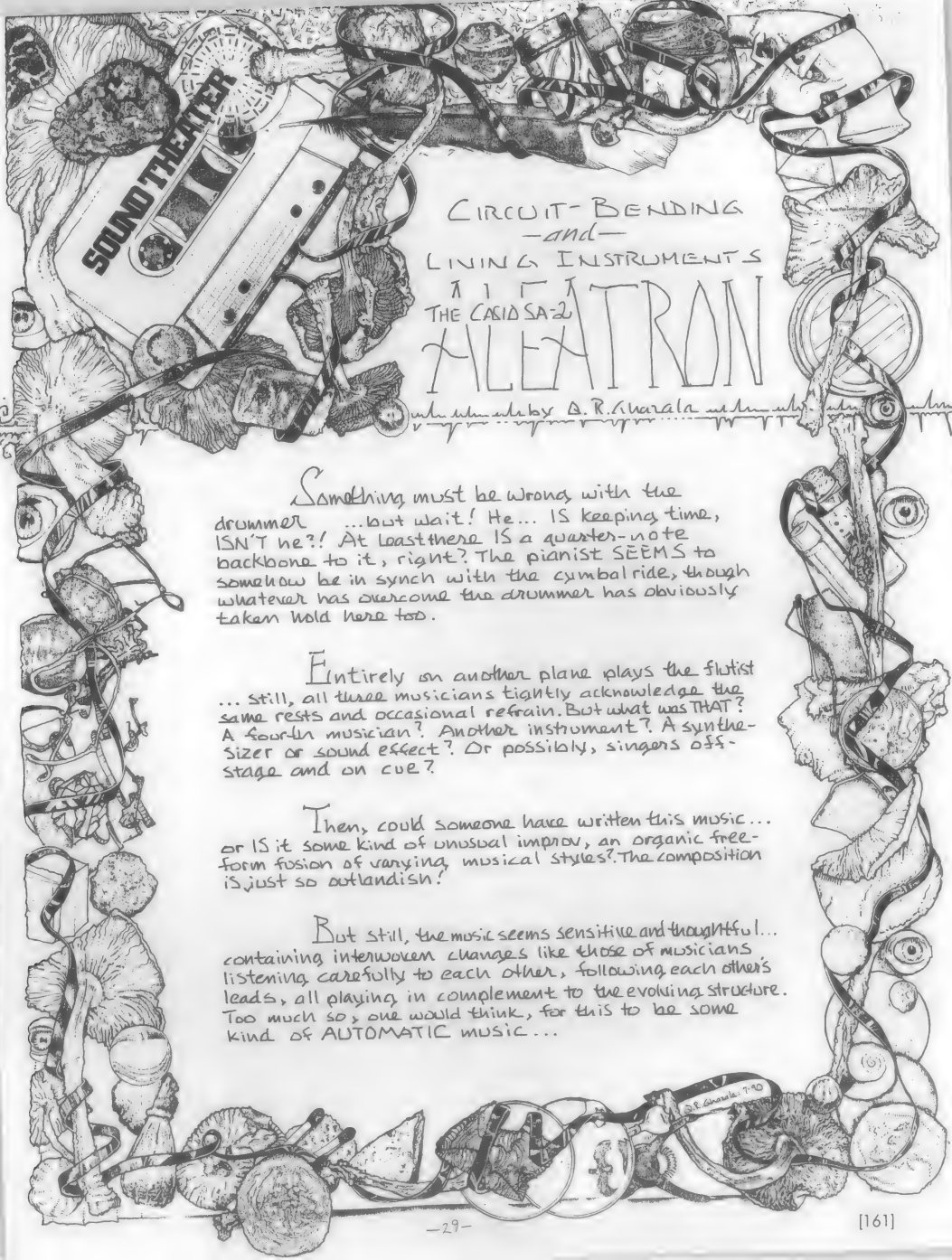
The Improvisor: http://www.nwrain.com/~rotcod/improv.com

The Surfophone, musical instrument for 3D virtual world: http://www.mygale.org/07/gaiv/nyxinst.htm

Dwain Wilder; flexifrets fretting system for adjustable tuning: http://www.servtech.com/public/dwilder

Elephant Lightfoot bamboo saxophones: http://www.asiaplus-usa.com/bamboosax

Neanderthal flute (presumed prehistoric bone flute): http://www.webster.sk.ca/greenwich/fl-compl.htm



CIRCUIT-BENDING —and— LIVING INSTRUMENTS

THE CASIO SA-2 ALEATRON

by A.R. Kwasnik

Something must be wrong with the drummer ...but wait! He... IS keeping time, ISN'T he?! At least there IS a quarter-note backbone to it, right? The pianist SEEMS to somehow be in synch with the cymbal ride, though whatever has overcome the drummer has obviously taken hold here too.

Entirely on another plane plays the flutist ... still, all three musicians tightly acknowledge the same rests and occasional refrain. But what was THAT? A fourth musician? Another instrument? A synthesizer or sound effect? Or possibly, singers off-stage and on cue?

Then, could someone have written this music... or IS it some kind of unusual improv, an organic free-form fusion of varying musical styles? The composition is just so outlandish!

But still, the music seems sensitive and thoughtful... containing interwoven changes like those of musicians listening carefully to each other, following each other's leads, all playing in complement to the evolving structure. Too much so, one would think, for this to be some kind of AUTOMATIC music...

THE CASIO SA-2 ALEATRON

By Q.R. Ghazala

(continued from previous page)

All fields have their hallmarks. My experience with circuit-bending* has, over a period of thirty years, resulted in the development of several distinct technical categories born of the process, each best represented by a specific instrument or two. These main categories would include body-contact control, human voice synthesis, digital samples, the equal-tempered scale and, lastly, aleatoric instruments. That is, chance composition devices. I've come to call instruments that produce aleatoric music through the electronic process of circuit-bending* *aleatronic* instruments, or the result of *aleatronics*.

But how about an instrument that stretched beyond single category and represented the entire scope of circuit-bending's possibilities? An instrument that involves body-contacts, human voice synthesis, digital sampling, the equal-tempered scale and automatic chance composition. All present and in fine example. That would be a true hallmark instrument.

Such an instrument exists. It's easy to circuit-bend, is current stock and can be purchased for between twenty and thirty dollars (see mail-order information at article's end if your local stores can't supply). This instrument is the Casio SA-2, a small 32-note keyboard with a large set of built-in sounds to work with. There are thirty-two accompaniment patterns for circuit-bending to reshape. These include seemingly sampled percussion instruments whose high-quality recording really shines through, adding a sparkle of live performance to the countless (re)arrangements now obtainable. A bank of sixteen instrument voices is also provided. These may or may not be sampled. They are, however, high-quality voices, most with rich overtones. While the keyboard is described as only 2-note polyphonic, circuit-bending changes all this. In fact, very complex pitch clusters and orchestrations result from the new anti-theory electronics.

A single push-button trigger switch and body-contact — features which are not standard on the instrument as manufactured, but which can be added to the instrument in the circuit-bending process I'll describe later — are sufficient to nudge the SA-2's programs into wondrous disarray, resulting in original composition sequences looking to the five categories above...

Here the body-contact, rather than implementing pitch-bend or other frequency shaping as is its function in many other circuit-bent instruments, is used to advance the aleatoric musical structures. A delicate touch upon the brass contact increments the rhythmic and tonal frameworks at the heart of the chance compositions, continually pushing them forward into new combinations of indeterminate events.

In the realm of human voice synthesis ... no, the SA-2 does not come supplied with such capabilities. Still, on a number of occasions, startling human-like vocalizations arise. Murmurs, chants, shouts and odd singing might materialize and disappear as the music evolves. The emotive effect of these shadowy utterances can be powerful and revealing ... a Rorschach image in sound.

Digital samples are fascinating to dissect under the diffracted light of circuit-bending. As mentioned before, the SA-2's percussion sounds seem sampled, and all voices involve a digital capture scheme that has them nicely rendered in accessible sound files (probably **P**ulse **C**ode **M**odulation). Whereas analog signals tend to deteriorate into static-like decay when exposed to certain circuit-bending applications, digital signals break-down into distorted routines rather than distorted tones. The tones can therefore remain sharp while their harmonic content, envelope and assembly behavior is altered. Likewise, just as it is with the musical notes, digital percussion sequences are similarly transformed. Cymbals become backward gongs, kick-drums blend into bass lines, snare drum decays are frozen into crystalline seas of sizzling metallic hiss.

Generally, keyboard instrument = equal tempered scale. The very nature of circuit-bending places it in the opposite corner of this scheme of order, from conceptual foundation to vocalizations. Perhaps this is why the combination of the two conflicting sensibilities can be so catalytic. Here, within the circuit-bent SA-2, there is created a riveting interface between these two disparate worlds, elements of the familiar bound together by an invasive disorienting matrix.

Lastly, as an experimental aleatoric instrument, and considering its modest original design along with the simplicity of the required circuit-bending, the SA-2 is truly outstanding. The vast range of indeterminate compositional structures it generates is mind-boggling. From overt stylistic changes to subtle arrangement shifts, the enticing development within the individual aleatoric pieces makes the modified SA-2 an experimental music box of rare personality. Another point of interest is that, unlike the somewhat ambient and sustained planes of composition of many other circuit-bent instruments, the SA-2 Aleatron's chance music often seems more goal-oriented in that a focused drive to augment and build within the movements can be heard. The SA-2 does not always take this direction in its composing. But when it does, I must say I find this aspect intriguing.

In a moment I'll describe the modification procedure, but first a look at possible circuit-bending control options. Central to prompting the SA-2's electronics into unique tonal synthesis and aleatoric music production is a push-button triggering switch, the most important circuit-bending addition. This switch disrupts the instrument's program routines. Several choices exist as to where to connect the switch to the circuit. Any of these will initiate aleatoric composition. In use, with or without keyboard keys being held down, and with or without a rhythmic accompaniment playing, the musician quickly and lightly taps this push-button switch while listening to the results.

Any number of things may happen. The entire circuit may crash. Silence. No response anywhere until the main power switch is turned off and back on. More than likely, the keyboard will become inoperative while the sound circuit, cautious of the strange knock, decides whether or not to answer the door. Many

*"Circuit-bending" refers to the process of creative short-circuiting by which standard audio electronics are radically modified to produce unique experimental instruments. A further description of these techniques can be read in *EMI* Volume VIII #1, 1992.

FIRST PROTOTYPE
CASIO SA-2
ALEATRON

Original prototype with eight body-contacts and two push-button triggers. Body contacts modify voice textures as well as sequence audio changes such as loop contents and aleatoric structures. Speaker switch and RCA output at left of case.

SECOND
PROTOTYPE CASIO
SA-2 ALEATRON

This model looks to a simple control array of one body-contact, two push-button triggers, line-output and speaker switch. See "Modification Services" at article's end.

C-380 ALEATRON

Same principles applied to similar keyboard, the Concertmate 380 by Radio Shack. Three body contacts, three push-button triggers and panel-mounted trimmer. Good, but not as productive as the SA-2.

knocks might go unanswered. But when this obscure door does open to the world of anti-theory electronics, I've learned that anything might appear.

It could be a haunting voice, a single note of beguiling texture perfect for capturing as a sample and flying into a full polyphonic keyboard system. Abstract sounds might come forth ... tangles of sustained noise and pitch with evolving tonal clusters buried within.

Pushing the switch might cause a loop to begin. This loop could be percussion instruments revolving in odd rhythm, abstract sound cycles, musical notes repeating a melody, or combinations from dense to sparse of all elements working together. These repeating sound-forms may slowly fade away, hold steady or accelerate to crescendo.

Pushing this digital trip-wire will also, every so often, launch an aleatoric episode such as those described before. This chance composition, like certain loops, may also slowly accelerate to crescendo ending in any number of resolutions including tone clusters, silence, loops, pre-programmed rhythms or, occasionally, a new aleatoric sequence possibly again increasing in tempo through another complete cycle. The keyboard may or may not be active during loops and aleatoric passages. If so, it may or may not behave as usual, sometimes pulsing disassociated notes, producing sound effects or even modifying accompaniments in progress.

Pushing the same triggering switch during aleatoric progressions can shift elements within the music, altering perhaps the percussion pattern, the choice of lead instrument, the accompaniment scheme or a number of other sonic aspects affecting the flow of indeterminate composition. Again, pushing the button represents a certain degree of risk, not at all unfamiliar to circuit-bending, that could result in program crash. While it's true that the lost sound-form is probably gone forever, impossible to achieve in exactly the same way again, the bending process balances this out here and in many other instruments by providing a bottomless well of possibility for yet unheard musics, a chance to give life to new and unique sonic creations every time the circuit is turned on.

Of next importance among the controls to be added during the circuit-bending process is the body-contact. This brass ball acts similarly to the push-button trigger during certain sonic activity, but with a finer degree of control. As noted, by lightly touching this contact with a fingertip it is possible to initiate, increment or otherwise alter audio activity.

Beyond push-button trigger and body-contact, an examination of the circuit will reveal points for more body-contacts, this time altering voice textures. Points for the addition of peak envelope LEDs and power indicator LED are also available with a little searching. Speaker cut-off switch and line-output for amplification and recording can be installed. This is a good idea since circuit-bending brings about a wide frequency range way beyond the reproduction capabilities of the built-in speaker and evident only through hi-fi sound systems.

Several push-button triggers could be connected to various components within the appropriate area of the SA-2's circuit board in place of the one I've discussed as example, each trigger with a threshold potentiometer to govern its degree of effect. A complete work-up could result in a heavily-modified SA-2 with a dozen or more controls and alterations, including full case refinishing. A top-end model is definitely on my to-do list (as is trying to find that list's other end).

SA-2 MODIFICATION INSTRUCTIONS

Upon opening the unit you'll notice a large central integrated circuit. Just beyond either end of this IC will be seen separate clusters of electronics. One cluster will contain another IC. The *other* cluster, the smaller one, contains a number of components that when wired together to each other through push-button switches and appropriate resistors will trigger the audio behavior described.

First you'll need to obtain a 4 AA-cell battery holder like those available from Radio Shack. Load the batteries into the holder and connect the wires to the battery-contact springs protruding from the SA-2's circuit board. The black (–) wire goes to the spiral contact; the red (+) wire goes to the "L"-shaped contact.

Next, splice a 1K trimmer pot (potentiometer) in the middle of an 8" wire and adjust the pot to its central position (around 500 ohms). Begin making momentary connections between resistors within the said cluster; note which connections prompt interesting audio behavior. Implement these discoveries with miniature push-button switches mounted on the instrument's case.

The only tricky part here involves precise adjustment of the trimmer pot for each push-button circuit. Too much resistance will not provide enough electrical force to trigger substantial changes. Too little resistance will immediately crash the circuit. Once the several push-button circuits are found, each with its own sound-prompting quality (strong, weak, pitch or sound-effect related), setting the trimmers becomes critical. When set precisely, each quick tap of the associated push-button will have its best chance at producing an effect. This will become obvious as you experiment.

The body-contact is wired directly to one of the points within the same cluster. Several points will work; none work all the time. Which point works best depends on the audio behavior present. Trigger a loop and begin touching resistor leads with an all-metal jeweler's screwdriver. Hopefully you'll find a lead that advances or somehow alters audio present. Solder a wire to that lead and connect the other end to a body-contact of your choice. **NOTE:** If circuit crashes during any testing procedure, reset with main power switch.

For reasons both direct and coincidental, this article (and instrument) grew out of my last *EMI* article covering the circuit-bent Casio SK-1 sampling keyboard, or the Escapist Sample Shuttle (*EMI* Volume 12 #2, December 1996). Inspired by the new synthesis realities of the modified SK-1, I explored the SA-2 discovering its captivating sonic properties. But I write about it now also to introduce it as a simpler and more economical alternative to the SK-1 (which is no longer being manufactured and is difficult to find in any case). While, due to its complexity, I had to turn away a number of requests to build the circuit-bent SK-1, I can now offer a simple and affordable modification service for bending the SA-2 (see below). More so, I think you'll be surprised how easy the new wiring is to perform yourself, should you decide to give it a try. No doubt, this is a great project with which to begin exploring the art of circuit-bending.

By the way, it turns out there wasn't anything wrong with the drummer after all. In fact, he wasn't even there.

The Casio SA-2 can be ordered from GLOBAL PRODUCTS at 1-800-633-0633. Price with postage will be $30.

(more) →

SA-2 MODIFICATION SERVICES

While I tend to develop my presentation designs to the stage of wide control arrays and special visual finishes (as seen in my catalog), the SA-2 becomes so strong an experimental instrument with only a few modifications that I've decided to offer a 7-part circuit-bending package to interested parties for $120 if I am supplied with purchaser's SA-2 in cushioned return-ready box. Or, $165 if I order keyboard and then box to ship.

The 7-part package includes 2 specialized (short-throw) push-button triggers, 2 fine-tuned trimmer potentiometers, brass body-contact, RCA line-output and speaker cut-off switch (see photo #2). These controls will implement all effects described.

I'm fairly confident that anyone interested in experimental music or instruments, whether focused on electronics and aleatoric composition or not, will be thrilled with the SA-2 Aleatron. Deep-end models with additional controls and special visual treatments are also available. Inquiries and checks made out to Reed Ghazala can be sent to:

Reed Ghazala c/o The Anti-Theory Workshop, Sound Theater, 3325 South Woodmont Ave., Cincinnati, OH 45213, USA

Website coming soon at http://www.anti-theory.com
Present website at http://www.iac.net:80~cage/reed.html.
E-mail: qrg@anti-theory.com

Reed's full-color *Anti-Theory Workshop* catalog is now available. A visual treat itself, the 8-panel brochure depicts 18 different instruments and three of Reed's recent music packages. To receive a copy send $1 and a self-addressed stamped envelope to the workshop address above. For more information on the Anti-Theory Workshop and instruments available, see the ad in the Notices section of this issue.

NOTICES

earart, an exhibit of works from a wide range of instrument makers, sound sculptors and makers of sound installations, will take place May 9-31, 1997 at 1078 Gallery in Chico, California. For more information on the exhibit, contact William Houck, (916) 345-1450, or e-mail spiritid@msn.com.[12-4]

A DEMONSTRATION/WORKSHOP by Tom Nunn will be held at Venue 9, 252 9th St., San Francisco, Sunday May 18, 1:30 - 4:30 pm. Tom is known for his unusual, sculptural musical instruments. This "tell all" workshop will cover tools, materials & supplies for construction, playing techniques, amplification & processing and more, with hands-on participation. Cost $15. Call Tom at (415) 282-1562 to register.[12-4]

Information wanted about the horned violins made in Burma or if anyone traveling to Burma would like to help with some research for a future *EMI* article please contact: Cary Clements, 1197 South Van Ness Ave., San Francisco CA 94110; phone (415) 206-9531; e-mail cary@coolbeans.com. [12-4]

Hydrophone (underwater microphone) wanted. Any suggestions for a source for them? If so, please contact Joe Cochran, 1605 Greenwyche Rd., Huntsville AL 35801; phone (205) 534-8118; e-mail invenanet@world-net.att.net. [12-4]

Harry Partch's *Genesis of a Music* is back in print in paperback at $17.95. Also available: *Bitter Music* ($44.95) and the *Dreamer That Remains* video ($34.95). Add $5 s&h per item. Send checks to Composers Recordings Inc., or e-mail your mastercard, visa or discover number. 73 Spring St., Suite 506, New York NY 10012-5800; phone (212)941-9673; e-mail CRInyc@aol.com. [12-4]

The Music Notation Modernization Association will hold its 4th International Conference in Cebu City, Philippines, July 8 - 11, 1997. For information contact Tom Reed at (816) 665-8098, write MNMA, PO Box 241, Kirksville, MO 63501, USA, or visit web site at www.i1.net/~metro/mnma.htm. [12-4]

Ndonga Mahwe — Return of the Spirit, a 9-track audio CD covering many different mbira styles, has been released by Spirit Talk Mbira. For information e-mail cd10@soas.ac.uk or flobob@mindspring.com. [12-4]

The 6th annual Zimbabwean Music Festival will take place May 16 - 18, 1997, in Victoria, BC, Canada. For information phone (250) 384-1997 or e-mail zmf97@islandnet.com. [12-4]

The Theremin Summer Institute and Festival will take place at the Portland Conservatory of Music June 15-21. There will be daily workshops with Bob Moog, Lydia Kavina and Eric Ross, with film screenings and concerts in the evenings. For information call the Portland Conservatory of Music at (207) 775-3356 or e-mail Olivia Mattis at olivia@ime.net.

"Dr. Bamboo" to visit Hawaiian Islands in July: Dr. Jules Janssen of the Netherlands will present a series of technical seminars for government, construction and building professionals on the practical uses of bamboo at various locations in the Hawiian Islands in late July. Sponsored by the Hawaii chapter of the Amnerican Bamboo Society. For information contact Richard Waters, phone (808)965-0955, e-mail bamboomuse@aol.com.

Affordable bamboo and gourd instruments made by us from American bamboo and gourds. Percussion aerophones, panpipes, didjeridu, drums and shekere ... Send for price list: alaBamboo Music, 3447 N. McGehee Rd. #111, Montgomery AL 36111. [12-3]

ORDER THE MUSIC OF THE GRAVIKORD, Bob Grawi's electric double harp based on the African Kora (featured in EMI, April 1988, and Bart Hopkin's new book *Gravikords, Whirlies and Pyrophones*). Cassette tapes $10; CDs $15 (+1.50 s&h) to White Bear Enterprises, PO Box 106, Florida NY 10921; 914/651-2327.[12-3]

Earthshaking Music '97 "World Music Source" is now available (Free!). 400+ cds, books, videos & cassettes. Instruments from everywhere! Submissions of research papers, videos, recordings, instruments, etc welcomed for inclusion in our catalog. Email to erthshkn@avana.net or call (404)622-0707. [12-3]

PHOTOGRAPHS OF GOURD MUSICAL INSTRUMENTS WANTED: A new book, *Gourd Musical Instruments*, is being written by Ginger Summit

and Jim Widess, authors of *The Complete Book of Gourd Craft* (Lark Books, 1996). The authors are soliciting instrument makers to send photographs of instruments, both traditional and non-traditional, in which the gourd is an integral part of the instrument. Send to Jim Widess or Ginger Summit, 926 Gilman St., Berkeley CA 94790. Photographs will be returned upon publication of the manuscript in 1998.[12-3]

The new book *Harry Partch: The Early Vocal Works 1930-1933* by Bob Gilmore can be ordered in the USA or Canada from the American Composers Forum, or in Britain from the British Harry Partch Society, 33 Arthur Rd., Erdington, Birmingham, Great Britain B24 9EX.[12-3]

The Oakland Museum of California (1000 Oak St., Oakland, CA 94607-4892) presents *Hello Again: A New Wave of Recycled Art and Design* from Feb 15 through July 27, 1997. The show is an exhibition of innovative and often surprising products created from recycled and reused materials, and will include, among other things, a number of musical instruments. For information, call 510/238-2200.[12-3]

For the best in automatic musical instruments, calliopes and fairground organs, as well as lots of other early Americana, look to the books and recordings from Marion Roehl Recordings, 3533 Stratford Dr., Vestal NY 13850-2222; phone 607/797-9062; fax 607/797-2624. [12-3]

UNUSUAL MUSICAL INSTRUMENTS WANTED especially mouthblown. Dr. Guy Grant, Bigfoot Music, 127 Sorell St., Devonport, Tasmania 7310, Australia. Ph/fax Australia 61 (3) 64 24 4957; guygrant@tassie.net.au [12-2]

ANONYMOUS FAMILY REUNION. I ("anonymous") think of everyone who's ever chosen to be "anonymous" as being part of the same "family." Whether people have been "anonymous" because of sex role oppression, possibility of criminal prosecution, rejection of egoism, mysteriousness, obscurity, sense of humor, or whatever, we have our "anonymity" in common — & I think it's time we met. Therefore, I propose a "Family Reunion" for the summer of 1997 to be at a location & time collectively decided on. Special accommodations can be made for those desiring secrecy. Please contact "anonymous" at 3809 Melwood Ave, Pittsburgh, PA, 15213, USA. [12-2]

THE WORMHOLE ... One of a kind, diamond in the rough? store in WPB, FL, seeks unusual musical instruments for consignment purposes. Please write ... or call ... Steve Rullman c/o Wormhole, 115 So. Olive Ave., WPB, FL 33401; phone (407) 659-3082. [12-1]

By Geary Thompson:
The Quartal System (introduction, using comparison graphics): $5.00 pp
The Quartal Concept (explanation of evolution and conception): $5.00 pp
The Quartal Guitar (chord and scale fingering reference): $10.00 pp
The Quartal Board (chord and scale fingering reference): $10.00 pp
Quartal, 6462 50th ST., San Diego CA 92120. [12-1]

EXPERIMENTAL AND ELECTROACOUSTIC RECORDINGS FOR SALE. Many unusual titles, such as Harry Bertoia, etc. LPs a specialty. Send for free listing to: SONIC TIGER MUSIC, PO Box 715, Cambridge, MA 02140 USA. [11-4]

Reed Ghazala's **Anti-Theory Workshop** is now offering circuit-bent Incantors, Trigons, Photon Clarinets, Morphiums, Aleatrons, one-of-a-kinds, CDs and collected writings. For Reed's full-color, visually stunning brochure/catalog/fractal artwork depicting 18 instruments, CDs, friendly raccoons and more, please send $1 (or any interesting tidbit of your choice) to: Reed Ghazala c/o **The Anti-Theory Workshop**, Sound Theater, 3325 South Woodmont Ave. Cinti., OH 45213. Present web:
http://www.iac.net:80/~cage/reed.html. Coming soon:
http://www.anti-theory.com E-mail: qrg@anti-theory.com [12-3]

GRAVIKORDS, WHIRLIES AND PYROPHONES – a new book-and-CD boxed set from *Experimental Musical Instruments*, produced in conjunction with the publishing company Ellipsis Arts. A book-and-CD combination devoted to new and unheard-of musical instruments from some of the world's most interesting and inventive musical instrument makers. Informative text describing the instruments and the thinking behind them, wonderful photographs and great recordings. Every track of the CD and page of the book overflow with the ideas and the originality of the featured builders. 37 musical instrument makers appear in the book, with music from 18 of them included in the CD. Price $29.95 for the book and CD (no shipping charges for U.S. air mail or overseas surface rate; add 25% for overseas air; California residents only at 7.25% sales tax), available from EMI at PO Box 784, Nicasio, CA 94946, USA; phone/fax (415) 662-2182; e-mail ExpMusInst@aol.com Visa & Mastercard accepted. [12-3]

Musical Instrument Design: Information for Instrument Making, by Bart Hopkin, editor of *Experimental Musical Instruments*, published by See Sharp Press. *Musical Instrument Design* presents underlying principles for the design and construction of acoustic musical instruments of all sorts, with a practical, hands-on approach. NO OTHER BOOK book gathers this information under one cover. Just under 200 pages long; large format; fully illustrated. $18.95 plus $2 s&h. (This covers air mail shipping within the U.S. or surface rate overseas; for overseas air add 25%. Customers in California add 7.25% sales tax.). Order from *Experimental Musical Instruments*, PO Box 784, Nicasio, CA 94946, USA, phone/fax (415) 662-2182. [11-4]

The EMI Wall Chart is a beautiful 24" x 36" wall poster, with graphic design by Gwendolyn Jones, covered with practical reference information relating to musical instruments and instrument making. Suitable for workshop, living room or art gallery. Some of the material on the chart replicates material in the *Musical Instrument Design* book (see previous ad), but since the wall chart format has its own advantages, you might be happy to have both. The price is $12. (No additional shipping charges for air mail within the U.S. or surface rate overseas; for overseas air add 25%. Customers in California add 7.25% sales tax.) Order through *Experimental Musical Instruments*. [11-4]

Making Simple Musical Instruments: A Melodious Collection of Strings, Winds, Drums & More — A book by Bart Hopkin, editor of *Experimental Musical Instruments*, published by Lark Books. It is a collection of plans for home-buildable musical instruments, ranging in difficulty from simple to moderate. The book is written for a general, non-specialist audience, and the approach is non-technical. The instruments aren't so very far out: most of them relate to familiar instrument types and are playable as such. Yet even experienced experimenters will find some new ideas here. It's hardbound, with 144 big and very full pages, lots of color, beautiful photos & illustrations; price $24.95 plus $2 s&h. (This covers air mail shipping within the U.S. or surface rate overseas; for overseas air add 25%. Customers in California add 7.25% sales tax.) Order from Experimental Musical Instruments, PO Box 784, Nicasio, CA 94946, USA, phone (415) 662-2182. [10-4]

Air Columns and Toneholes: Principles of Wind Instrument Design is a spiral-bound booklet containing the four articles on practical wind instrument acoustics by Bart Hopkin that appeared in EMI in 1992 and 1993. The articles have been much revised and improved, and there are several additional features included. Published by Tai Hei Shakuhachi; available for $14.00. (This covers air mail shipping within the U.S. or surface rate overseas; for overseas air add 25%. Customers in California add 7.25% sales tax). Order from EMI, Box 784, Nicasio, CA 94946. [9-4]

DISPLAY ADS IN EMI are more affordable than you might think. $60/half page, $40/quarter page, $25/eighth page. If you have a product or service that you'd like to promote just a bit more conspicuously, call or write for details: EMI PO Box 784, Nicasio, CA 94946; phone/fax 415/662-2182.

SUBSCRIPTIONS TO EMI: $24/yr for U.S.; $27/yr for Canada & Mexico; $34/yr overseas. Order from EMI, Box 784, Nicasio, CA 94946, USA. Visa/MC accepted.

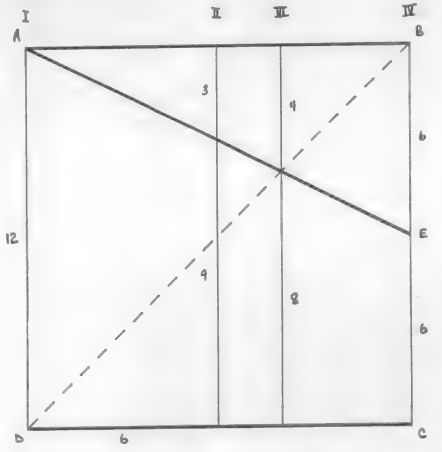
EMI BACK ISSUES: Bound volume sets Vol 1 through Vol. 10: $17 per volume. Each volume set contains all of the issues of one volume year, photocopied and bound under one cover. The photocopies are a step down in quality from the original press runs, but they are decent as photocopies go, and they are fully readable. Indiviudal back issues from Volume 11 and later are available in the original press run at $6 each. These prices cover air mail shipping within the U.S. or surface rate overseas; for overseas air add 25%. Customers in California add 7.25% sales tax. Visa and MasterCard accepted. Order from EMI, PO Box 784, Nicasio, CA 94946, or write for a listing of back issues and their contents. Corresponding cassette tapes are available for later volumes; see information below.

CASSETTE TAPES FROM EMI: Each cassette in the EMI cassette series contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny and beautiful music. Volumes 6, 8, 9, 10 and 11 are available. (Volume 12 will be available after July 1997. Other earlier volumes are now sold out). The price is $8 per cassette. No additional shipping charge for air delivery in the U.S., surface delivery overseas. For overseas air add 25%; in California add 7.25% sales tax. Order from EMI, Box 784, Nicasio, CA 94946. Visa and Mastercard accepted.

THE HELIKON

By Mitchell Clark

The most important of the instruments of classical Greece were those with strings. Among them the various types of lyre — such as *lyra*, *kithara*, *barbitos*, and so on — were themselves the principal stringed instruments. Harps were also in use, and lutes were introduced in the later classical period. In early Greece, instruments of the zither type are mentioned only occasionally in textual sources; two names that have come down to us are *simikon* and *epigoneion*. It appears that such instruments were used only as tools for the demonstration of tonal intervals, and not as performing instruments.[1]



Among such zithers used for demonstrations of matters of music theory, there is described in theoretical texts one of simple form called *helikon*. The name refers poetically to Mount Helikon, the home of the muses. The *helikon* is described in two musical treatises, *De Musica* ("On Music") by Aristides Quintilianus[2] and *Harmonica* ("Harmonics") by Ptolemy.[3] Ptolemy lived during the second century AD; there is debate as to when Aristides Quintilianus lived — it may have been as early as the second century AD or as late as the fourth. Aristides' description of the *helikon* is brief and fairly rudimentary, whereas Ptolemy's is more detailed, and is followed by his own elaboration on the device. Here we'll examine the first of these two forms of *helikon*.

The *helikon* differs from the earlier monochord, where a string was divided into segments by a movable bridge and only one sounding length of the divided string was used. In the *helikon* a number strings are divided into two portions, both of which can be used for demonstration of pitches. It was Didymus, in the first century AD, who saw that both portions of a divided string could be utilized for their pitches, and indeed by the time of Ptolemy the tradition of using the monochord was no longer continuous.[4]

The *helikon* is of interest for its simplicity of demonstrating, in basic geometric terms, the harmonic relationships of the perfect consonances plus the tone: 2/1, 3/2, 4/3, and 9/8. The design of the instrument can be conveyed in a straightforward geometric diagram which functions as a schematic, as in the accompanying illustration.[5]

The basic format of the *helikon* is that of a square, ABCD. A bridge runs from A to E, a point halfway along BC. Four strings (I, II, III, IV) of equal length and under equal tension are stretched between two parallel bridges — AB and CD (shown as bold lines) — on opposite sides of the square. String I is placed at one side of the square, at AD; IV at the opposite side, at BC. String II is placed equidistantly between I and IV (bisecting the square). The position for string III is determined by the place along bridge AE (shown as a bold line) that would intersect an imaginary diagonal drawn BD (shown as a dashed line). A perpendicular is dropped from AB to this point and down to CD: this forms the position of III.

Seven string lengths will be produced. String I is the full length of one side of the square (AD). If this is given the value of 12, the remaining lengths, proceeding counterclockwise and in decreasing length, will be:

lower portion of II: 9
lower portion of III: 8
lower portion of IV (EC): 6
upper portion of IV (BE): 6
upper portion of III: 4
upper portion of II: 3

If the pitch E_2 is given to string I, the seven pitches will be: $E_2 A_2 B_2 E_3 E_3 B_3 E_4$. Note that there is some confusion in M.L. West's *Ancient Greek Music*, where he incorrectly gives the note series — without counting the duplication at EC and BE — as $E_2 A_2 E_3 A_3 B_3 E_4$.[6] The duplication of the E_3 seems significant, as the first occurrence (EC) constitutes the completion of the lower octave, positioned in the lower portion of the instrument, and the second (BE) constitutes the commencement of the upper octave, positioned in the upper portion of the instrument.[7]

In *Harmonica*, Ptolemy goes on to describe a second, more involved, form of *helikon*, which makes use of a pivoting bridge to allow for more detailed examinations of intervals than does the simpler form, also described by Aristides Quintilianus. In the conclusion of his examination of the *helikon*, Ptolemy weighs the advantages and disadvantages of each version, giving points to the first form — which we've looked at here — for its simplicity, and points to latter form for its versatility.[8]

NOTES

1. M.L. West, *Ancient Greek Music* (Oxford et al: Oxford University Press, 1992), 78-9 and 225-6.

2. Aristides Quintilianus, *De Musica* Book III, Chapter 3; translated in Andrew Barker, ed., *Greek Musical Writings, Volume II: Harmonic and Acoustic Theory* (Cambridge et al: Cambridge University Press, 1989), 498-9.

3. Ptolemy, *Harmonica* Book II, Chapter 2; translated in Barker, *Greek Musical Writings II*, 319-22.

4: West, *Ancient Greek Music*, 240-1.

5. The illustration here, in its labeling of points and line segments, follows more closely the version of the *helikon* shown in West, *Ancient Greek Music*, 241 (his figure 8.3), than that given in Barker, *Greek Musical Writings II*, 320, in the translation of the Ptolemy text.

(continued on following page lower left)

RECORDINGS REVIEWS

By Warren Burt, Bart Hopkin, Dean Suzuki and René van Peer

JOHN CAGE: **SONATAS & INTERLUDES FOR PREPARED PIANO**
(Maro Ajemian, piano)

On CD from Composers Recordings Inc. CRI CD 700

HENRY COWELL: **PIANO MUSIC**

On CD from Smithsonian/Folkways. CD SF 40801

The subject matter of this magazine reaches well beyond the invention and design of new instruments. I like to think of it as an ongoing tribute to the spirit of inventiveness and independence of mind. This qualification applies without any doubt to Henry Cowell and his erstwhile student John Cage. Both of the CDs reviewed here are re-issues of LP albums of music that these pioneers wrote for that most unbending of instruments, the piano. (Well, the pipe organ is another such phenomenon, with possibly even more weight attached to it; not only because of its size, but also because of religious connotations. For those who enjoy deflating such balloons, check out two compositions that the Hungarian composer Gyorgy Ligeti wrote for it in the 1960s: *Etüden* and *Volumina*.)

Cage's *Sonatas & Interludes* for prepared piano are of course a milestone, a culmination of his research into sound. This CD comprises the first integral recording of the work, played by the pianist to whom it was dedicated, Maro Ajemian. It is clear that it was written well before Cage turned to chance operation as a compositional device. There are melodies, chords, rhythms. In fact, that is what you hear on Cowell's CD as well. But both also have this other layer of almost abstract and pure sound, that seems to have acquired a life of its own. It even seems to act as a subversive element in the music, clashing with the melodic content. At the same time music and sound reinforce one another.

With Cowell the dark rumblings and growls of clusters in the lower register suggest supernatural powers, as do the whistly whisperings evoked by stroking the fingers along open strings. Through the invention of new playing techniques Cowell (who plays all the pieces on the CD and comments upon them in the final track) achieved an emotional and spiritual depth that I find far more impressive than the devotion oozing from Messiaen's religious music and contemporary New Age styles.

Listening to the *Sonatas & Interludes* with ears steeped in music from the last decades I was surprised to find that, apart from the sounds created by the preparations, the treatment of melody and rhythm show Cage's roots in the Western tradition quite clearly. The preparations, however, seem to divide the sound world of the piece into different transparent planes. Superimposed upon one another, sounds from one shine through the others. One may perhaps conceive of them as concentric spheres, or as life zones — each with a character of its own.

One is gong-like, another sounds wooden without definite pitches, yet another wooden but with pitches; then there is one where strings are slightly off-key, lending tones a rich bell-like resonance; there is one area where each tone comes with a short buzz; one area sounds like conventional piano. It is this conglomerate of sounds and a certain coolness in the music that gives it its otherworldly quality.

Both these CDs document landmarks of music which was once recognized as revolutionary. The music itself is now historic, though to me it still has a very appealing freshness. The state of mind from which it sprang hopefully will never become outdated, even if this world does not easily tolerate departures from the mainstream.

—RvP

FROM SCRATCH: **PACIFIC - 3 2 1 ZERO**

On CD from Kiwi Pacific Records, SLC-236; PO Box 826, Wellington, New Zealand

ECHO CITY: **SONIC SPORT 83 - 88**

On CD from Gramophone Records, GR001; c/o Giles Perring, 7 Mornington Terrace, London NW1 7RR, UK

The New Zealand group From Scratch and Echo City from the United Kingdom have several things in common. Both operate from a sense of social awareness and responsibility, both use self-built instruments for their music, both have as their most eye-catching instrument an array of tubes played on one end. From Scratch call these Slap Tubes; Echo City has dubbed them Batphones, after the beaters they use.

Pacific - 3 2 1 Zero has been named after its first track, which was composed as a response to the nuclear testing begun on atolls in the region shortly after the end of World War II. Starting with a drone that is at once ominous and luscious this is a lament, rife with anger at the suffering inflicted on islanders by nations that regard their arms development as more important than human life and the living conditions in the Pacific. The musicians use the sound possibilities of their instruments to full effect, often weaving hocketing lines into lively textures. This is mirrored in the way they chant the names of islands that have been used as testing grounds, threading and weaving syllables into a repetitive ritual song as if to exhort the listener never to forget what is being done to our world in the name of dominion.

Large PVC tubes (some straight, others bent and corrugated) produce a characteristic sound that combines a percussive thump with a rounded breezy tone. The straight tubes are arranged in a row, rather like huge panpipes. They are part of the percussion stations, one for each performer. For the first track these are set up in a triangular floorplan resembling the logo of the Campaign for Nuclear Disarmament; for the second track the floorplan looks like an eye. Obviously the instruments are meant to be seen as well as heard.

This holds good for Echo City's instruments as well. *Sonic Sport* — their second CD after *The Sound of Music* (reviewed in *EMI* Vol 10 #4, June 1995) — is a re-issue of their first LP, ending with previously unreleased recordings from projects in which they invite members of the audience to participate in the music. Most of the pieces from the LP are concise and precisely structured, and were recorded in studios. Unfortunately, as is often the case, the instruments are not described; on the other hand, a list telling which instruments are played on what track, may serve as a kind of sound guide. Among these are the Batphones, sounding like particularly percussive bass guitars; and Baliphones, five of which seem to appear from behind a pair of didgeridoos on "Singaraja Bemo Ride." They have a vibrant ring to them that is more metallic than that of the Australian instrument.

The two final tracks document different public activities of the group. "Doddy No Diddy" was recorded during the Covent Garden Music Festival in 1988. Members of the audience took part in this performance

(Helikon notes, continued from previous page)

6. West, *Ancient Greek Music*, 241.

7. As this upper portion of the *helikon* ascends above the bridge AE from right to left, a theoretical conundrum, if not a paradox worthy of Xeno, appears: can we say that at the point A is an infinitely high transposition of the pitch class *E*?

8. See Barker, *Greek Musical Writings II*, 321-22.

COMING IN A FUTURE ISSUE: Author Mitchell Clark looks at modern forays into the recreation of ancient Greek music and musical instruments, as exemplified in CDs and LPs from four contemporary music groups.

which was conducted by Peter Hamill. Its effect is informal and exuberant; this is carried to an extreme in "Weaver's Field Band," a compilation made from recordings in what Echo City call a sonic playground. This term describes perfectly what the installations are intended for, and what they sound like. Here are kids having noisy fun. Other playgrounds have been set up for disabled. But no matter who plays on these instruments, this is truly sonic sport — it is teamwork, it is physical, and it's a thoroughly enjoyable pastime.

—RvP

GREAT BOWING COMPANY: **NOMAN**

Mountain Music, MM#001. CD from Colin Offord, PO Box 279, Katoomba, NSW, 2780, Australia

The Great Bowing Company is the creation of Colin Offord, sculptor, composer, performer and instrument builder. While the company normally consists of between 5 to 9 members, the music on this CD is the collective creation of four of the members, Peter Kennard, James Pattugalan, Matthew Doyle, and Offord himself. Each of the pieces showcases a different combination of Offord's instruments, his voice, and other instruments. The opening, "Prelude," is a short solo voice improvisation, and sets the stage for the rest of the album, with Offord's pure hyper-expressive falsetto keening modal melodies and ornamenting held notes with vocal harmonics. Harmonic playing and singing feature prominently in the following "Paperbark Country," a duet for Offord on his Great Island Mouthbow, and Matthew Doyle on didjeridu. Offord is multitracked on this and most of the subsequent tracks, allowing him to both sing and change the mouthbow timbre at the same time. Until I found this out, I was quite perplexed as to how he managed to be moving his mouth in two ways at the same time! Offord's mouthbow playing is a treat. His development of the mouthbow, and its great variety of playing techniques, allows him to be a timbral and textural one-man band.

"Longing/Hunter's Rhythm" is a trio which begins with a solo by James Pattugalan on the Bambudat, a set of bamboo log drums, joined again by a multitracked Offord on Mouthbow, voice, and home-made bamboo flute, and then by Kennard on frame drums. "Xyloptia," in my opinion the loveliest track on the album, features Peter Kennard playing Offord's Xyloptia, a xylophone made from Bailer Shells, which have a beautifully haunting sound, some very striking deep mouthbow from Offord, a recording of ocean waves, and a vocal line at the end.

"Heartlines" is another duet between Doyle and Offord. This time, Offord plays conch shells, while Doyle, as before, contributes a striking rhythmically and timbrally varied didjeridu line. In both duets with didjeridu, it is similarities with the didjeridu that are emphasized. In the first, the changing harmonic spectra produced by both mouthbow and didj are featured, while in this track, it's the buzz-lipped sound and pitch bending shared by both the didj and the conch shells that provides the main musical material. "Country and Eastern #2" is an improvised glossolalic song in a folk/Celtic vein accompanied by plucked Mouthbow, drum kit, and other percussion. The final track, "Detritus," is again a multitracked trio between Offord, Kennard and Pattugalan. Opening with Offord on his Moonbells, harmonically rich slabs of aluminum, it progresses into some very remarkable textures, featuring some arresting timbral stabs on Mouthbow, and some beautiful textural playing. I wasn't as impressed with the second half of this track, where everyone joined into a rhythmic groove. I think this section would be more effective as a dance accompaniment. On its own, it seemed, to my ears, to be straining too hard to sound heroic and ecstatic. Others, though, might find it an appropriate finish to this timbrally, rhythmically and melodically attractive album by four virtuosic players.

—WB

ELA LAMBLIN: **SCULPTAURAL**

On CD from Elalusions, 711 37th Ave., Seattle, WA 98122

Ela Lamblin is a young Seattle-based sound sculptor who came to the genre through the visual arts. With rather little knowledge of the field, Lamblin approached his art in an initially naive, innocent way, coupled with a sense of wonder and a healthy dose of ambition and drive.

Lamblin has been further fostered in the experimental tradition by his association with the UMO Ensemble, an experimental theater group from the Seattle area for which he is the music director. Their works grow out of improvisations based on an agreed-upon theme or premise. In their performances, Lamblin is considered a full member, appearing in costume and engaging in some peripheral acting. His sound sculptures play an integral role as both visual and sonic components of the larger theatrical work. While Lamblin's contributions are not fully integrated components after the manner of Wagner's *Gesamtkunstwerk* (complete or total art work), they are part of a synergistic whole that would be significantly lessened by their absence.

As a young artist and one who is fascinated by exploration, experimentation and novel invention, Lamblin has not limited himself to a particular instrumental type or design. His sculptures cover the gamut of sound productions: idiophones, membranophones, aerophones, chordophones, metallophones, and more. And as one might expect from one who has training and background in the visual arts, his works are wonderful to behold. His CD includes numerous, albeit small photographs — it makes one long for the LP format or at least a large box with an equally large photo essay — of the instruments used in the recording. The instruments range from simple items such as a various kelp instruments, including flutes and saxophones, the Toe Flute, a long, thick, end-blown flute played with the feet, and the Lookfar, a small steel-string harp, to larger, more sculptural and much more elaborate constructions. Among these is an instrument called the Stamenphone. This instrument began as a purely sculptural object which later manifested sonic possibilities. A large (ca. 5' tall) and complicated construction of re-bar and cable, steel and brass, it vaguely resembles a gigantic stamen with other floral components, hence the name. The long, thin cables and re-bar, as well as other portions of the object, are mostly bowed with a double bass or cello bow. Lamblin has marked out nodes along the cables which he touches while bowing to get finely tuned harmonics. The sound, rather like some exotic, buzzing bowed zither, is resonant and distinctive and Lamblin proves to be a gifted performer and composer/improviser. His Bellwheels feature simple bells (like those found on old-fashioned bicycles) which are mounted on bicycle wheels and can be struck with a triangle beater or bowed as the wheel rotates, and the spokes can also be plucked. The basic concept of the Bellwheel has evolved and metamorphosed into much more creative and sophisticated instruments including Soundcycles (musical bicycles) and the Orbitone, a large acrobatic swing, which, as you might deduce, combines sculpture, musical instrument and acrobatics.

It turns out that Lamblin is not only a gifted sound sculptor, but also a fine musician. Though he has little training as a performer, his quasi-improvisational works on the Stamenphone are both virtuosic and beautiful. Based on drone elements or clear tonal centers, his works frequently feature some kind of repetitive elements, as well as non-Western, especially Eastern and to a lesser degree African stylistic elements and gestures. Some may find that the New Agey sound of some pieces is a bit naive or over-done, but others will find the music enchanting and engaging, and always very well played.

Unlike many other instrument builder/inventors, Lamblin has not begun to specialize in a particular genre of instrument and one can only look to the future with anticipation for the fantastic instruments that will be borne of this artist's fertile imagination.

— DS

ALBERT LESKOWSKY:
MUSIC FOR THE INSTRUMENTS OF AN EXHIBITION

On CD from Albert Leskowsky, Zimay u. 6, Kecskemet, Hungary

The insert of *Music for the instruments of an exhibition* shows a grasshopper that is entirely made out of clarinets. This is quite an appropriate illustration of the ease with which through the use of electronic devices any sound can be made to sound like anything else, or like nothing at all, if need be. Now that we're approaching the turn of a

millennium some declare history finished and others pronounce culture a patchwork of derivations. If this is not an era of confusion, it is at least one of fusion — recombining elements to try and come up with something new. The results range from the magnificent to the disastrous. This has to do with the elements used (one just cannot go wrong with Tibetan Buddhist chants, it seems); it has to do with how they are combined, too.

Experimental instruments are presented in all kinds of ways. They can be played solo, they can be part of an ensemble of relatives. They can also be surrounded with regular instruments — to show how nicely they contrast with these, or to show how well they fit in.

Albert Leskowsky from Kecskemét, Hungary, has a collection of some 1500 instruments which he shows to the public in a permanent exhibition. In order to promote the collection he has made this CD. Each track features some of the exhibits, in combination with mainstream instruments, such as electric guitars, keyboards and a sampler; in addition each represents a combination of popular styles.

The list of musicians who played on this CD is quite long. Leskowsky must have a lot of goodwill in Hungarian music circles. It is also evident that composing and recording these pieces must have been good fun. People play with an appealing looseness. More's the pity that the jokes often do not really work. There is a Hungarian rap (the first ever, according to Leskowsky), another track mixes a Hungarian folk tune with African rhythms; "Hurdy-gurdy March" has this instrument backed up by guitars, modified through fuzz boxes.

The music is so light and informal, one wonders in how far making it was taken seriously. Too often the instruments from the collection lose their distinctiveness among samplers, electronic drums and other pop music instruments. As a showcase I don't think this CD does full justice to the marvels that Leskowsky has in his possession, blurring rather than highlighting them.

There is a group of musicians and actors in Hungary who organize workshops for children in museums, telling stories and playing music. What I've heard from some of them so far is playful, funny and well made. Maybe they should be allowed to play with these instruments; give a bunch of kids a great time and who knows if they'll come up with some pieces that would match the quality of Leskowsky's collection.

—RvP

IVANO TORRE: **PRIMADORAINPOI**

On CD from Altri Suoni, PO Box 804, CH-6962 Viganello, Switzerland; e-mail: sfranchini@vtx.ch (Altri Suoni AS 023)

The Swiss drummer Ivano Torre has expanded his percussion set with some instruments that he himself developed, the Calottophone and the Lamophone (from Italian for 'cap' and 'blade' respectively). The former is a collection of hubcaps suspended in a frame. Torre plays them with a variety of beaters, some of which he made for this purpose. They sound somewhat similar to the bronze bells of a gamelan, though perhaps a bit more tinny, depending on where they are hit. The Lamophone consists of blades from circular saws, hung from horizontal bars. They have a deep bell-like sound, with a very long decay. They are stroked, hit and rubbed — all according to the sound Torre wishes to coax from them.

His music is an exploration of time and timbre. *Primadorainpoi*, Beforenowhereafter in English, is divided into twelve pieces that have been arranged in groups of three, thus in a sense following the progress of the hands around the dial of a clock. The titles have mythical and ritual overtones. This is reflected in the dreamy, unhurried quality of Torre's music; in the repetitiveness of the rhythms; in the spacious sonorities of the metals. The liner notes state that "it is certainly difficult to recognize in this musician the boy who, in the train, remained enraptured listening to the rhythmical cadences of the wheels when passing over the rail switches and joints." In fact this music sounds to me exactly like it has been invented by someone who is fond of railway journeys. At times the rhythms have the hypnotizing bounce of wagon wheels that dissolve time — dozing off, you feel being dragged along, whilst floating in a motionless here and now.

—RvP

HAL RAMMEL, JOHN CORBETT, TERRI KAPSALIS: **VAN'S PEPPY SYNCOPATORS**

Penumbra CD 003, from Penumbra Music, PO Box 282, Grafton, WI. 53024

An album of very sparse and delicate improvisation from multi-instrumentalist Hal Rammel, guitarist John Corbett, and violinist, poet, and actress Terri Kapsalis is offered up here. Rammel plays a musical saw, a triolin (a circle of metal rods in a triangular wooden resonator base, described in *EMI*, vol. III, no. 4, Dec. '87), a single-string snath (otherwise left undescribed, but which sounds to me like a single-string bowed instrument similar in range to a violin, but with more high and less low resonances, and which also allows some very fast plucking effects), and percussion. Corbett plays guitar in the myriad of ways contemporary guitar improvisers do, and Kapsalis bows, scrapes, and plucks her violin, while in five of the fourteen pieces reciting some delightful and very odd surrealist poetry.

References to surrealism abound in this CD, in fact, with two pieces referring to George Herriman's "Krazy Kat," comic strip and one track entitled "Fur-Lined Cup (for Meret Oppenheim)," after one of the icons of the surrealist movement. And the structure of the music reflects surrealist thinking as well — the free improvisational methods used here are very similar to the surrealist technique of "automatic writing."

The playing is often gentle, whimsical, and perhaps, as befits its subject matter, slightly and bemusedly worried, or anxious. This is immediately apparent in the first track, named after a quote from Herriman ("The World. When It Gets to Be What It Is — Will It?") with a nervous ostinato on Corbett's guitar complimented by Rammel's saw and Kapsalis' violin. Despite this being a trio album, many of the pieces consist of alternating short solos with only the occasional duo or trio section. The playing is mostly textural and timbral — only in a few places, such as in parts of the last track, "Pindrop Serenade" is the focus of the music on melody. In some tracks, such as "Evil Walks With Beauty…Beauty With Evil…and Yet…and Yet (for Ignatz and Krazy)" the piece is almost exclusively made up of scraping, plucking, dragging and rustling sounds. Even the musical saw is played percussively in this elegantly shaped improvisation.

Kapsalis' poetry adds another dimension to the mix. The work of other experimental poets, who also combine written text with improvised music, such as Chris Mann, Ivor Cutler, or Robert Ashley come to mind, but Kapsalis has her own powerful and distinctive voice. The different kinds of humor in each text, such as the gentle rural humor of "Corn Etiquette," or the macabre, black humor of "Handless," (the story of a nightmare date where the heroine is gradually and accidentally hacked to pieces, but doesn't make a fuss because she "wants to impress" her date by being cool), only slightly conceal the political bite and anger behind the texts. Combined with the trio' s sparse and texturally oriented playing, the effect can sometimes be amusing, and sometimes downright chilling.

When I first listened to this CD, I was startled by the spare and barren textures of the music. On subsequent hearings, things began to knit together for me. Now I hear it as a series of elegant, pleasing, and slightly disturbing musical musings. How good it is that there are still people out there, like Rammel, Corbett and Kapsalis, who value understatement and introspection.

—WB

FIFTY FOOT HOSE: **CAULDRON**

CD from Big Beat Records, 46-50 Steele Rd, London, England. More information on the World Wide Web at www.acerecords.co.uk.

This is a true story: I recently bought a low-end version of one of those tiny Discman CD players. When I got it home, I hooked it up to the previously CD-less sound system in my office and inserted the first CD that came to hand to give it a test run. To my exasperation, the brand-new player didn't work properly. No matter how I messed around with the controls and the connections, all I could get out of it was a sort of electronic rumble, suggesting the fragmented sound of a disk reader that isn't tracking right. Eventually it occurred to me to try skipping ahead to the next cut on the CD. This one played fine, and I finally realized that

the disk player wasn't malfunctioning. What I had been hearing was the first track of the CD as it was intended to sound. Opening up the CD's liner notes booklet later, I came across this note at the bottom of the first page: "Track one is a two-minute oscillating tone. There is nothing wrong with your CD player."

The CD was *Cauldron*, the 1996 re-release of an LP originally recorded in 1967 by the group Fifty Foot Hose. Several additional tracks from the same time period have been added for this re-release, along with extensive new liner notes. The music comes out of San Francisco's psychedelic scene of the late sixties. In sound and mood it's very much of that time and place — and yet in some respects it's not: Fifty Foot Hose was never an entirely comfortable fit in the Haight and at the Fillmore; they never developed a large following, and *Cauldron*, their one LP, was not a big seller. The group's affinities were often closer to the electronic and avant-garde music of the time; yet because of their rock affiliations the doors to that world were not open to them.

The group's basic instrumentation was standard rock — electric guitars, electric bass, and drum set — with the addition of a cobbled-together pre-synth electronics set-up created by the founder of the group, Louis "Cork" Marcheschi. Here is his description of his instrument: "It was based on dual tube-type audio generators, with a Hohner Echolette, a Dearmond combination foot-operated volume/tone control, a 12" plastic outdoor speaker from WW2 aircraft carrier mounted horizontally, assorted microphones and fuzzboxes, two theremins — one I built, the other I bought from a man who used it to scare kids on Halloween — a twelve-foot-long cardboard tube and a five gallon tin container. I had a combination of two or three amps, and a mixer, and I ended up feeding everything through everything else, so I could actually have one tone bend or clip another, or just head-on collide and create a third, unique tone."

The standard rock side of the instrumentation as it's captured here is, to my ear, the essence of "the San Francisco sound" (which I grew up with) ... the excitable guitars, the rhythmic imprecision of the ensemble, the out-of-kilter live mixes, the awkward vocals. In some of the pieces on this CD Marcheschi's purely electronic sounds seem to integrate with the rock instrumentation. In others the juxtaposition comes across as arbitrary, even humorous. The prize goes to "God Bless the Child." The Fifty Foot Hose rendition of the Billie Holiday classic, with Marcheschi's spluttering and chirping electronics superimposed over a sort of questionable lounge-act reading of the tune, is positively surrealistic — a masterpiece, I say without irony, in a genre that I'd be hard put to define.

In fact, the electronics are splendid throughout, and all the more so in light of the time in which they occurred and the materials that Cork Marcheschi had to work with. In several short pieces on the CD the electronics are featured alone. In addition, a few of the full-length tracks with fuller instrumentation also seem to have been conceived primarily as works of electronics and signal processing. Particularly striking among these is the title piece, "Cauldron," in which voices representing the witches of *Macbeth* are electronically reworked and manipulated, anticipating work with altered vocals by composers of a later, more facile digital era.

The *Cauldron* CD also contains what the liner notes refer to as "the notorious 'Bad Trip' single." Marcheschi recorded "Bad Trip" in 1966 with members of an earlier group called The Ethix, and it was released as a single in 1967. (The story of its release, as recounted in the liner notes, is very funny.) The piece is a manic cacophony of screaming, distorted guitars and electronics thoroughly living up to its title, and upon its release it became a cult classic. For some reason, while it was mastered at 33 rpm, no playback speed was indicated on the label. As it appeared in the standard 45 rpm single format, it's likely that the great majority of listeners heard it at the higher speed, never knowing the difference. For that reason, "Bad Trip" appears on the CD twice — once at real-time speed, and again in the doubly manic speeded-up version.

These recordings constitute a remarkable artifact, at once emblematic of a particular time, ahead of their time, and timeless.

—BH

BOOK REVIEWS

by Mitchell Clark and Bart Hopkin

ROBERT A. GREEN:
THE HURDY-GURDY IN EIGHTEENTH-CENTURY FRANCE

Bloomington and Indianapolis: Indiana University Press, 1995

Reviewed by Mitchell Clark, with an appendix covering recordings of hurdy-gurdy works of the period

It would appear that few musical instruments have been subject to such widely oscillating vicissitudes of public opinion as the hurdy-gurdy. The instrument in question here is that stringed instrument consisting of melody and drone strings — not the popularly known barrel organ (*cum-simian*). The strings are sounded by a rosined wheel set into motion by the player's right hand, and melodies are played by means of a small keyboard operated by the left hand. The hurdy-gurdy appears to have been initially used in church music, only later to become associated with the entertainments of blind beggars. The instrument has a continuous history of possibly as long as a millennium, and it has been conjectured that the hurdy-gurdy is the only musical instrument truly indigenous to the continent of Europe.[1]

Robert Green's *The Hurdy-Gurdy in Eighteenth-Century France* is an in-depth study on the use of the hurdy-gurdy in France during the Baroque era. Known in France as *vielle*, or *vielle à roue* ("wheel-*vielle*," referring to the wheel that sounds the strings), this instrument found an important place in both court music and domestic music during the eighteenth century, along with the *musette* bagpipes — another "pastoral" drone instrument.

Chapter One of *The Hurdy-Gurdy in Eighteenth-Century France* covers the historical background of the hurdy-gurdy, with, of course, special emphasis on the history of the *vielle* in France and its musical role in the century or so that preceded the French Revolution. Chapter Two focuses on the music written for the *vielle* in France during the Baroque, which includes that of composers such as Charles Bâton, Joseph Bodin de Boismortier, Michel Corrette, and Jean-Baptiste Dupuits, among many others. Stylistic features of French music in general and of music for the *vielle* in particular are examined.[2] Chapter Three begins with an overview of *vielle* organology, and continues with a discussion covering points of the interpretation and performance of French baroque works. This is of special interest to *vielle* players, but is also useful to non-players in explaining some of the unique aspects of instrument. Chapter Four is a highly detailed repertory list of the music for *vielle*, solo and in ensemble, during the period under consideration. Although the book includes only a half-dozen or so illustrations, it is generous in its musical examples. The inclusion, at each example, of the tuning used for the drones for that example would have been a helpful reference.[3] Also, the 109-page book has, curiously, no index.

The first appearances of the *vielle* in "respectable" music in France were in the 1660s, in ballets of Jean-Baptiste Lully. This earlier form of the *vielle* (see Green's Illustration 1) was pitched in D, with melody strings in octaves and with drones in D and A. In the 1710s, the instrument was modified by Henri Bâton, with melody strings in unison and drones in C and G. At this time, the body was redesigned to have a shape like that of a lute or a guitar (see Green's Illustration 6) — and indeed a *vielle* could be made by re-using the body of one of these instruments. A satirical essay by François Campion, published in 1739 (and quoted in part by Green on pp.21-22), tongue-in-cheekly stated that such a recycling was the only use at that time "for theorbos, lutes and guitars. These gothic and despised instruments are as a last resort turned in *vielles*: that is their grave." As Campion was the greatest guitarist of his day — and was witnessing a decline in the popularity of his instrument — he obviously objected to such cannibalization.

In historical accounts, much has made of the vogue of the *vielle* among the French aristocracy during the reigns of Louis XIV and Louis XV, especially as a plaything of less-than-talented amateurs. The music written and arranged for the *vielle* during this period tends to be overshadowed by such assessments. As we learn from *The Hurdy-Gurdy in Eighteenth-Century France*, there were indeed professional composers and performers who created and played sophisticated and intelligent music for the *vielle*. Like composers in other instrumental media, they were concerned with expanding the boundaries of the vielle's idiom — no mean feat, as the presence of the drones hampered wide-ranging harmonic movement. As a scholar and player of the instrument, Robert Green is clearly out to champion the mid-18th-century chamber music for the *vielle*, and to deliver it from stereotypes attached to it. An underlying premise of Green's study is to examine the story of the hurdy-gurdy free of the biases and assumptions which have associated themselves with this instrument long considered to be of "low class" and therefore beneath serious study. But the hurdy-gurdy, together with bagpipes, jew's harps, and other "rustic" instruments, have contributed greatly to the color and texture of European music for centuries.

* * * * *

A few recordings of the *vielle* music of the French baroque are available. One by Robert Green himself, *French Music for Hurdy-Gurdy* (FOCUS {USA} 932), includes a survey of original *vielle* works, including compositions by Joseph Bodin de Boismortier, Michel Corrette, Jean-Baptiste Dupuits, Philbert de Lavigne, and A. Tolou, as well as 18th-century arrangements of two pieces by François Couperin. It is interesting that few, if any, of the pieces of which Green speaks most highly (or in most detail) in his book are represented in his recording. As an example, after spending more space on the composer Jean-Baptiste Dupuits than on any other, and speaking with such praise of his *Pièces de*

caractère (Op.5; 1741), Green represents Dupuits on his recording by only one such character piece.[4] This piece, *Le Guerrière*, is quite interesting in its sequential exchange of dance-like triplet figurations with military-fanfare motifs in duple time, but seems perhaps a minor work compared to *pièces de caractère* as musically complex as *L'Unique* and *Le Labyrinthe*, which Green describes in his text.

Another recording, *La Vielle à Roue Baroque* by the French player Françoise Bois-Poteur (Disques Pierre Verany {France} PV788052), includes a less-varied program — but it is in some ways more interesting than Green's recording, and is played on a richer-sounding instrument. In *Les Missions*, Bois-Poteur has arranged into two little suites a number of anonymous 18th-century arrangements, by Jesuit proselytizers, of popular tunes. A suite by Charles Bâton for *vielle* and *musette de cour* bagpipes shows off the wonderful sonic combination of these two drone instruments in a series of *pièces de caractère* and dance movements. The bulk of the album is in four suites of *amusements* by Nicolas Chedeville, which take us through some 25 character pieces and dances for *vielle* and harpsichord, showing this combination in a variety of musical contexts.

Robert Green concludes Chapter 2 of *The Hurdy-Gurdy in Eighteenth-Century France* with mention of a few French Baroque works for other instruments, in imitation of the *vielle*. Perhaps the best known is François Couperin's satirical *Les Viéleux, et les Gueux* ("The *Vielle* Players and the Beggars") from his set of harpsichord pieces *Les Fastes de la Grande et Ancienne Mxnxstrxndxsx*, itself part of the eleventh *Ordre* (1716-17). One recording of *Les Fastes* (among many) is Raymond Touyère's *François Couperin-le-Grand* (Gallo {Switzerland} CD-854). In *Les Viéleux, et les Gueux*, Couperin's writing for the plucked strings of the harpsichord captures the bowed-string sounds of the *vielle* surprisingly well, and Touyère plays the short piece with much gusto.

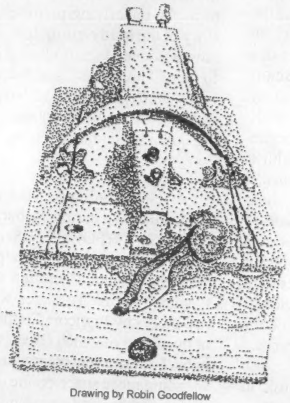
NOTES

1. On this, see Christopher Page, "The Medieval *Organistrum* and *Symphonia*: 1: A Legacy from the East?" in *Galpin Society Journal* 35 (1982): 37-44, and "The Medieval *Organistrum* and *Symphonia*: 2: Terminology" in *Galpin Society* Journal 36 (1983): 71-87.

2. Also see Robert A. Green, "Eighteenth-century French chamber music for *vielle*" in *Early Music* 15 (November 1987): 468-79, for further detailed information on this repertoire.

3. For example, Chapter 2, Example 2: an excerpt from a suite by Michon. Without consulting the text relating to this musical example, one may well assume that what is shown is a piece in g minor (two flats in the key signature), and that such a piece would have drones tuned to G-d-g. The piece is actually in c minor (one flat sign is omitted from the key signature, as may occasionally be found in Baroque music in a minor key "towards the flat side") and the drones would be tuned to C-G-c.

4. Dupuits' works indeed do seem to be quite exceptional, and he may be considered the most musically sophisticated of the eighteenth-century *vielle* composers. David Fuller's article on Dupuits in the *New Grove* also speaks highly of his works (although not of its featured solo instrument), stating that they merit more than "the total obscurity into which they have fallen, even though many are written for so unsatisfactory an instrument as the *vielle*." (Stanley Sadie, ed., *The New Grove Dictionary of Music and Musician* [London: Macmillan Press Ltd / New York: Grove's Dictionaries of Music Inc., 1980] Volume 5: 736-7).



Drawing by Robin Goodfellow

MICHAEL J PAGLIARO: **EVERYTHING YOU SHOULD KNOW ABOUT MUSICAL INSTRUMENTS BUT DIDN'T HAVE TIME TO LEARN**

Published in 1992 by Columbia Pacific University Press, San Rafael, CA; distributed by Ardsley Musical Instrument Services Ltd., Scarsdale, NY; phone 1-800-VIBRATO

Unfortunately, the text of Michael Pagliaro's *Everything You Should Know About Musical Instruments* suffers from some misconceptions, particularly the portions that deal with acoustics. Even parts which are accurate are sometimes confusingly or misleadingly written.

On the plus side (and this is what makes the book worth mentioning in a review here), this is one of the few books on musical instruments written from the point of view of the instrument manufacturer, rather than the hobbyist or individual craftsperson. The mechanical descriptions of various instrument types, which appear to be accurate, contain a fair amount of useful information — for example, an extensive chart indicating dimensions for all the standard brass instrument mouthpieces, and diagrams depicting and identifying every component in the elaborate keying systems on standard woodwinds. The instruments covered are transverse flute, clarinet, saxophone, oboe, bassoon, standard brass instruments, and the violin family.

—BH

REYNOLD WEIDENAAR:
MAGIC MUSIC FROM THE TELHARMONIUM

Published in 1995 by The Scarecrow Press, Inc., Metuchen, NJ and London

This review is reprinted from *Notes: Quarterly Journal of the Music Library Association*, March, 1996, by permission of the Music Library Association.

The Telharmonium, developed by the inventor Thaddeus Cahill over a period of years starting around 1890, was one of the first electronic musical instruments. But it was more than that phrase would suggest. The Telharmonium was a hugely ambitious project. Several basement rooms in a large building were required to house its workings. In another room above were the complex keyboards by which the sounds were controlled, ideally by two, three or four musicians.

The Telharmomium's tone production mechanism was similar to that which later appeared on a far smaller scale in the Hammond Organ: sets of iron wheels were made to rotate very close to electromagnetic coils. The periphery of each wheel was not truly circular, but had a toothed or wavy pattern. As the wheel turned, the movement of the protrusions through the magnetic field surrounding the coil induced an alternating current in the coil, with a frequency corresponding to the number of teeth on the wheel and the speed of rotation. The sound came about by sending this signal through some further processing and an elaborate bank of controls, and

ultimately to an early precursor of the loudspeaker. The instrument was capable of multiple tone qualities, employing the principles that we now know as sound synthesis — an exotic and highly theoretical idea at the time.

It was the intent of the inventor that the telharmonium would be the instrument that would render obsolete all others, recreating the sounds of all known instruments, only better. Further, it was expected that it would reach a wider audience than any previous instrument. While concerts were given in the hall that housed the instrument itself, the primary aim was that the music should be transmitted by wire to remote locations, to homes and public places, for people far and wide to enjoy. At times, during the instrument's brief heyday, telharmonium concerts were transmitted through existing telephone lines. At other times they were sent through wires dedicated to telharmonic service, strung like those of any other public utility through the streets of New York.

At its inception this extraordinary creation generated a great deal of excitement in the press, in the general public, and among investors — and then, within a few years, it fizzled entirely. Whether or not it should be seen as a success from a musical point of view, the telharmonium proved to be an economic failure, and on a grand scale.

In *Magic Music from the Telharmonium*, Reynold Weidenaar recounts the history of the telharmonium and its inventor Thaddeus Cahill. Weidenaar's account is not at its best in describing in detail the instrument and its workings; rather, his telling works best as social history. Several factors come together to make this an interesting story.

One of those factors is business. Much of Weidenaar's text is devoted to Cahill's struggles to raise capital, promote the product, and keep the company afloat. Business dealings may be a dry topic, but the people and the dreams that fuel them are not.

Another is the special angle Weidenaar's book provides on the interplay between society and technology. The telharmonium came along at a time — not unlike our own — when new technologies were becoming available, but the directions they would take remained unformed. Ways of doing things that we now take for granted had not yet locked in place; controlling economic forces had not yet cemented their control; and some very different approaches remained perfectly plausible in such areas as the dissemination of music and information by radio or cable. To see how these forces played themselves out by following one of the approaches that *didn't* succeed is an interesting exercise.

While much of this book has a narrative quality, Weidenaar adheres to scholarly conventions, including extensive footnotes and a bibliography of almost a hundred pages. There are forty-seven graphic figures, including some wonderful old photographs of serious-looking people dwarfed by rooms full of electronic components and elaborate keyboard set-ups.

The book will be of value to scholars interested in the history of music technology, and also, though less obviously, to students of early 20th century social and economic history. The subject matter is probably too obscure to attract the interest of a broader audience, yet I can imagine that even non-specialists might enjoy the story of a dream, as improbable and quirky as it was visionary, pursued doggedly and then, finally, lost.

—BH

The following is a list of selected articles relating to musical instruments which have recently appeared in other publications.

"Sing Rollercoaster Sing: The Rube Goldberg Music Machines of George Rhoads," Bob McGuire interviewed by Jeff Bagato in *Mole* #10 (PO Box 2482, Merrifield, VA 22116).

Bob McGuire discusses the sound sculptures of George Rhoads, with whom he has worked closely for two decades. Rhoads' "delightfully complex ... audiokinetic machines" use lots of visibly moving parts to create an array of sounds.

"The Wires Sing, and I Listen... the wire music of Alan Lamb," Alan Lamb interviewed by Chris Rice in *halana* Volume 1 #2, Winter 1996-97 (PO Box 502, Ardmore PA 19003-0502).

The Australian sound artist discusses his many years recording and working with the music of telephone wires sounded, primarily, by the wind.

"A History of the Chinese Seven-string Zither in Vietnam" by Mitchell Clark, in *Nhac Viêt: The Journal of Vietnamese Music*, Volume 4 #1, Spring 1995 (PO Box 16, Kent, OH 44240).

A discussion of the historical use, drawing on written documents, of the Chinese *qin* zither in Vietnam in both solo and ensemble music. Reference is made also to the use of the *qin* in Japan and Korea.

"The Pedal Harpsichord" by Colin Booth, in *Continuo* Vol 21 #1, Feb 1997 (29½ Sheather St. #4, Hammondsport NY 14840-0327).

Information on modern reconstructions of harpsichords with organ-style pedalboards, from a contemporary maker.

"Kawai in the U.S.A.: U.S. Piano Plants Produce 1,000 Units per Month for Customers Around the World," no author credited, in *The Music Trades*, January 1997(80 West St., PO Box 432, Englewood NJ 07631).

Information, mostly commercial in orientation, on the Japanese piano-making company Kawai's U.S. factories. Included are several photographs of machinery used in the manufacturing process.

"The Sonic Doom of Vladimir Gavreau" by Gerry Vassilatos, in *Borderlands* Volume LII #4, 4th quarter 1996 (PO Box 220, Bayside CA 95524).

A discussion of deleterious effects of infrasound and its use as a weapon of war, with historical reference to research conducted during the cold war.

"Nocturnal Disturbances... and the Infrasonic 'Hum'" by Gerry Vassilatos, also in *Borderlands* Volume LII #4 (address above).

References to unexplained humming sounds have appeared widely in recent years. The author provides some perspective on these reports and some of the explanations that have been offered.

"Chladni Glitter Testing: A Useful Experimental Technique for Harpmakers" by Jason Eyster, in *Folk Harp Journal* #94 (4718 Maychelle Drive, Anaheim CA 92807-3040).

"Chladni patterns" are the patterns formed by particles of sand, salt or similar matter placed upon a vibrating body and allowed to dance about and ultimately collect in the body's regions of minimal vibratory movement, thus delineating its patterns of vibration. This article discusses the use of Chladni patterns in assessing harp sound boards.

Music For People's Resource Catalog 1997 (PO Box 397, Goshen, CT 06756-0397).

This is the annual resource catalog put out by Music For People, a membership organization specializing in participatory music, improvization, and an active, communal approach to music making. The catalog includes where-to-find information on various sorts of instruments and equipment, teachers, books & videos, workshops, children's music materials, etc.

AMICA Bulletin Vol. 34 #1, Jan/Feb 1997 (515 Scott St., Sandusky, OH 44870-3736) contains a reproduction of an ad or promotional flyer for the Rolmonica, an early mouth-blown device involving a player-piano-like paper roll and harmonica-like free reeds. Also included are a listing of tunes available on Rolmonica rolls, plus a wonderful, if faded, picture of a troop of mischeivous-looking kids of a bygone era playing Rolmonicas.

AMICA Bulletin Vol. 33 #6, Nov/Dec 1996 (address above) contains several articles on both the culture and the technology of early automatic musical instruments. To highlight just one of the articles: "Duo-Art Roll Speeds and Recording Methods" by Rex Lawson gives technical and historical information on the mechanisms by which the roll-perforator machines for Aeolian Company's Duo Art Reproducing Piano did their job.

Musicworks 67, Winter 1997 (179 Richmond St. West, Toronto, Canada M5V 1V3) contains several articles on the theme of "Instruments and Architectures":

"Notes on an Aural History of Architecture," by Ted Sheridan, is an essay on historical and contemporary thought regarding architectural design as it relates to sound environments.

"Sound Design for Loisaida, Manhattan," also by Ted Sheridan, discusses the author's sound-oriented architectural design for a particular area in Manhattan.

"An Interview with Fergus Kelly," by sean o huigin, covers the work of this Irish sound artist. Kelly has made percussion aerophones, pyrophones, coil-spring instruments and other homemades, but it's his thinking about sound work, more than the instruments themselves, that comes across in this interview.

American Lutherie Number 48, Winter 1996, contains articles on the construction of guitars and other stringed instruments, including —

"Cranking Out Baroque Guitars" by Lawrence K. Brown: Notes from a maker of baroque guitars — not normally thought of as mass-market item — on the small-scale application of mass-production techniques.

"The Guitar Neck: Its Design and Physics," by Ervin Somogyi: Fine points about guitar neck shape and curvature, including design principles equally valid for other fretted instruments.

"Sources: Plans," edited by Cyndy Burton: A where-to-get-'em listing of sources for plans for the construction of a wide variety of stringed instruments.